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75 Years
A Prologue to the Future

THE COVER: "Black Beetle" after installation of derrick and other oil-drilling equipment off Gela, Sicily, coast, with 5,000-ton converted LST used as "tender," or supply vessel, for platform. Story can be found on page 872. The AIEE Petroleum Conference Program appears on page 867.

As the power goes . . . so go the operating costs at Intermountain Chemical Co.'s highly mechanized mining and refining operation. And every bit of this power—for digging, hoisting and processing of the ore—comes from Intermountain's power plant through 5kv non-shielded Okolite-Okoprene self-supporting aerial cables. They needed utmost dependability—and got it!

Heavy concentration of corrosive soda ash dust and severe environmental conditions have no effect at all on this aerial cable. Note the simple, low-cost support pole—no cross-arms needed—as well as the easy installation and splicing procedures used for this light weight, unshielded 5kv cable.

Okolite-Okoprene Aerial Cables withstand chemical contamination . . . assure continuous production at Intermountain

"These 5,000-volt aerial cables have withstood heavy concentrations of soda ash dust for eight years now," says Louis Ruffini, staff assistant to the maintenance superintendent for Intermountain Chemical Company of Wyoming. "They've proved to be invulnerable to temperatures as low as —40°F and as high as 120°. They've faced winds up to 70 mph, and they tested perfectly at 40,000 volts d-c. We expect them to be around a long time yet."

These facts are vital to Intermountain. The company depends almost completely on electrical power to mine trona ore and refine it into almost half a million tons of soda ash per year. That's why they stress the dependability of their Okolite-Okoprene, 3/c, self-supporting power cables with aluminum conductors, cables that distribute power to every sub-station in the mine and processing plant.

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where there's electrical power . . . there's **OKONITE CABLE**

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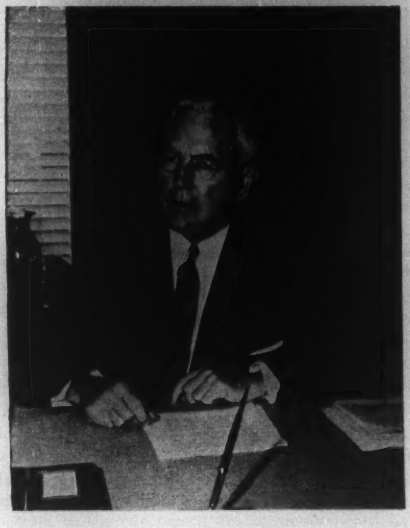


A Salute to the American Institute of Electrical Engineers

Anniversaries are times for looking forward as well as for pointing with pardonable pride to past achievements. In this spirit, I salute the electrical engineers of America upon the occasion of the 75th birthday of their professional society—the American Institute of Electrical Engineers.

The past achievements are very impressive. Electrical engineers have contributed mightily to advancing the American standard of living. Before the turn of the century, electricity spurred the development of the railroad, telephone, telegraph, and countless industrial developments.

Today, electrical engineering is intimately and inseparably involved in the lives of all of us. It makes possible the uses of light, heat, power, communication, and transportation without which we could not function.

Today, your profession faces new challenges in many fields. Automation and electronic computation are examples. Nuclear science and technology is another. The profession already has made significant contributions to nuclear engineering. It has teamed up with the scientists and other engineers to design the enormously complex instruments needed for giant particle accelerators and nuclear reactors.

In truth, electronics—the product of the electrical engineer—is the heart of our nuclear power development. Electronic instrumentation gives us the safety factor that makes possible the operation of nuclear power plants. Our progress in missiles, rockets, and exploration of space likewise is dependent on the ingenuity of the electrical engineer.

These are but a few examples of the necessity of continuing contributions from your profession to our daily lives and to the security and happiness of the peoples of the world.

The challenges are formidable. But electrical engineers are meeting this challenge. For my part, the record of the past 75 years is our assurance that they will rise to this and other opportunities for service to mankind.

John A. McCone
Chairman
U. S. Atomic Energy Commission

A I E E 75th Anniversary
1884 — 1959

75 Years—
A Prologue to the Future

The Road to Scientific Supremacy

RAWSON BENNETT

Scientific knowledge is a crucial factor in our struggle for survival and world peace but without the discoveries of basic research our technology cannot continue to advance. The chief of Naval Research discusses the ingredients of a basic research program that can assure our scientific supremacy.

THERE IS a groundswell of vocal public opinion which clamors for us to regain scientific supremacy. There is some reason to doubt that many of the advocates really know wherein scientific supremacy lies. But everyone in this group agrees that it is a goal we must achieve, and that it is a matter of the greatest urgency.

The Soviets have not given us much chance to become complacent, although some of us do our best. Their cosmic rocket of a few months ago has re-emphasized that we are dealing with a mighty foe with tremendous resources, both technical and material. Furthermore, they have the power to use their resources in any way they see fit without consulting the wishes of the populace.

Although we are all unanimous—or nearly so—that the achievement of scientific supremacy should be given top priority, there is general disagreement and confusion as to just how we should go about it. One of the basic troubles is that there are different opinions on just what comprises scientific supremacy. This has led some people to declare that we are still ahead of the Soviet Union, but that they are catching up fast and that we must apply greater effort to stay ahead. Others insist that we have fallen behind and that it is going to be a long, tough struggle to reassert our supremacy.

These gloomy voices invariably talk in limited terms of missile superiority and the so-called race into space. Their measuring device is simple. They consider that nation which has the ICBM (intercontinental ballistic missile) with the reported longest range, or has fired a rocket the farthest into outer space or launched the heaviest satellite, or will be the first to land on the moon, to be first. They leap with pain when the Soviets chalk up an accomplishment we have yet to match, whether it is brute-force engineering or a real scientific advance. Their theme song, to borrow from an old popular ditty, could be, "Anything they can do, we must do better." This is the kind of wasteful, enervating competition we must avoid. If we let this become our dominant attitude, we will soon find ourselves dueling with the Soviets on a field they have selected and with the weapons they have chosen.

Essentially full text of an address presented at a symposium "The Road to Scientific Supremacy," held during the AIEE Winter General Meeting, New York, N. Y. Feb. 1-6, 1959.

Rawson Bennett is chief, Naval Research, U. S. Navy, Washington, D. C.

COMPARISON IS DIFFICULT

WHICH NATION has the greatest scientific prowess? Frankly, I do not know. What is more, I am sure no one else does, because there are no means for making a realistic appraisal of who is ahead. One reason is that we have no universal standard of measurement. Comparative numbers of Ph.D.'s in science do not mean too much. Does the training and background of a Russian Ph.D. equal that of an American Ph.D.? We used to think not; now we are not so sure.

Another reason why it is difficult to measure a nation's scientific strength is that no piece of scientific knowledge belongs to any one nation. This country has never attempted to hoard its scientific discoveries, and in the past, especially in the prewar years, we have drawn heavily from abroad. If the United States had ever been foolish enough to utilize only scientific principles discovered by Americans, we would still be in the horse and buggy era. If the Soviet Union—despite what they say—had followed a policy of using only Russian ideas, they would be in an even worse fix. In fact, there would have been no revolution.

Is there any way we can make sure that scientific supremacy is at least within our grasp? Yes, there is—by concentrating on extending the depth and scope of our national basic research effort. If we see to it that this effort is properly nourished and supported, we need not worry about losing the race for scientific supremacy. In such a climate, important scientific progress is certain to be made.

Science is composed of many elements and many fields of interest. The American scientist is intent on exploring every one of them. He is encouraged to probe into any obscure corner of this mysterious universe that intrigues him. There is no one in Washington who dictates to the American basic scientist that he must concentrate his thinking on certain specific problems, or that he must prove something that supports our ideology. He sets his own pace and works on whatever problem that provides him with the greatest personal challenge. Out of this, a radically new military weapon is likely to evolve, but it is almost always an unplanned by-product of the minds of several men, each of whom individually and without thinking of the possible practical results solved a basic mystery of nature that made the weapon possible.

This is essentially how true basic research operates. No military or any other practical requirement triggers

the scientist's mind or channels his research. The pure scientist has no interest in dreaming up a new means of propulsion or a new type of electronics device or an improved rocket or missile. What he does have is a driving curiosity to unravel the how and why of unexplained phenomena. Sometimes his imaginative, but disciplined, curiosity impels him to find out what happens when certain forces are applied to certain objects. Eventually, he evolves a new theory about a chemical or physical reaction which is so basic that it becomes an essential feature of a new military system. The important thing is that unless such discoveries are constantly added to our storehouse of scientific knowledge, our engineers cannot continue to advance our technology.

FACETS OF BASIC RESEARCH

BASIC RESEARCH has certain characteristics which sets it apart from any other kind of scientific endeavor. First, it is a long drawn-out effort. Few projects can be completed in one year. Three years is more normal, and five years or longer is not unusual. In recognition of this, research contracts let by the Office of Naval Research (ONR) are not limited to one year and generally average three years. Not too infrequently they are extended.

The length of time required for basic research means that projects begun within the past few years have not yet had time to bear fruit. This gives us the advantage of time in our race for scientific supremacy. Ever since the end of World War II, American science has been engaged in an intensified program of basic research aided by Government organizations, private foundations, and industry. The Office of Naval Research established by Congress in 1946 was the first Government activity specifically designed to support basic research on a permanent continuing basis.

To digress slightly for a moment, let us recall the way in which the Office of Naval Research operates. Very seldom do we specifically ask for a piece of research. Normally, we receive proposals from many more resources than we can find. Selection is made on the basis of the idea, the competence of the principal investigator, and finally, some idea as to where the result could conceivably influence the U.S. Navy of the future.

Another characteristic of basic research is its uncertainty. It is a fact of life that this type of research can never be sure of what exactly will be discovered or how long it will take. However, no scientific search is ever wasted. Even negative results are valuable. Whenever we eliminate something that will not work, we are one step nearer the final answer.

In addition to imagination and patience, basic research also must have money, although a great deal can be accomplished with small amounts compared to development costs. The percentage of R&D (research and development) funds spent on basic research, however, is steadily increasing. In fiscal 1958, the total Federal Government expenditures in this area were $272 million or 8 per cent of the total Government R&D budget.

As is well known, a major part of the basic research in this country is performed by universities, academic institutions, and other nonprofit organizations, which must receive financial assistance from outside sources to carry on most of this work. About four fifths of the research work contracted by ONR is performed at these institutions, with most of the remainder performed by industrial laboratories. More than 140 colleges and universities and technical institutes are engaged in basic research sponsored by ONR. In all, we currently have more than 1,500 research contracts in various stages of progress, and these contracts are unclassified, without security restrictions.

NAVAL EXPERIENCE

THE NAVY'S LONG EXPERIENCE in supporting basic research has taught that the payoff is well worth the wait. We have discovered that by spending comparatively small sums to gain fundamental knowledge we have saved ourselves horribly expensive delays and frustrations in the equipment development stages. The Navy supports such a wide variety of research projects that it has a broad experience on which to evaluate the results of basic research.

The Navy requires new ideas and knowledge which can be applied to ships, aircraft, a variety of missiles—surface-to-surface, air-to-air, surface-to-air, and air-to-surface—and electronic communications and detection equipment based on land as well as installed on ships and aircraft. We are concerned with sending and receiving signals via the moon and through the ocean depths.

It is understandable, therefore, why the Navy has been a leader in radio astronomy for a number of years. Early in 1951, there was installed at the Naval Research Laboratory (NRL), which won renown as the birthplace of radar, one of the first large, high-gain, steerable, precision radio telescopes with a 50-foot parabolic antenna. Using this instrument, NRL radio astronomers in 1956 and 1957 detected for the first time microwave radio emissions from Venus, Jupiter, and Mars and radiation from the Crab nebula. One of the goals of radio astronomy is to develop high-gain, steerable, precision antennas and low-noise receivers. This would make it possible for a comparatively small instrument to reach a considerable distance out in space.

An approach to a low-noise receiver that is proving successful is the use of the solid-state maser microwave amplifier. The 50-foot reflector at NRL has for several months used experimentally a newly designed maser that uses a synthetic ruby as the amplifier. This has increased its effective range about 10 times. It has enabled this telescope to observe the extremely weak radio emissions from other planets, including Venus at the great distance of 75 million miles, as well as distant galaxies in collision. Another interesting project is that of ONR and the California Institute of Technology. In this installation two 90-foot dishes will be used together as a radio interferometer.

Radio astronomy is also one example of how a practical device can flow directly from basic research. This is the radio sextant. For many years all ships at sea have depended on celestial navigation with the sextant as the basic instrument. The disadvantage of the optical sextant, however, is that it can only be used when celestial bodies are clearly visible, which creates a problem when you have rain, fog, or snow. The radio sextant, on the other hand, tracks radio waves from the sun in all kinds of weather. It works through heavy overcast with an accuracy somewhat better than can be obtained in clear weather with the standard optical sextant. Since the sun is not available at night, we are working to develop a radio sextant with improved sensitivity which can obtain a fix on radio stars or extraterrestrial radio sources 24 hours a day under overcast skies. The radio sextant, incidentally, can be used beyond both the northern and southern arctic circles where magnetic compasses are ineffective.

Through research, the Navy has come up with one of the most significant advances in radio communications in a number of years. It is not widely known, but the first use of an earth satellite for relaying voice communications was not the recent Atlas satellite exploit. In 1951, scientists at the Naval Research Laboratory embarked on a research program using high-powered radars to study radio reflections from the moon, our oldest earth satellite. Their antenna was a parabolic reflector cut into the earth with an aperture of a little over one acre. This research established that the moon can be used as a passive radio relay station for carrying on a variety of radio communications. The Navy in announcing this about 1½ years ago revealed that voice messages have been successfully transmitted via the moon.

MAJOR RESEARCH TOOLS

Out of the navy's basic research program has also come the development of major research tools such as high altitude plastic balloons and research rockets. Both are designed for ONR's upper atmosphere research program, which has been in existence since 1946. The basic premise of this program is that accurate and detailed knowledge of the upper atmosphere can only be obtained by getting scientific instruments up there. Rockets are one way of doing this; and, since 1946, the Navy has been engaged in a comprehensive program of rocket research.

One goal we have been pursuing in this area is the development of simpler and more economical research rockets to be used as specialized research tools. Toward this end two small, lightweight, low-cost, solid-propellent rockets, known as the Arcas and the Arcon, were recently developed for the Navy. These rockets, the biggest only 11½ feet long and easy to launch, can carry instrument payloads to altitudes between 40 and 100 miles.

Another example of a simple specialized research rocket is a new tool for meteorological research. Known as Project Hugo, it is a rocket camera assembly which is able to photograph at extremely high altitudes the cloud formations associated with weather frontal systems. This knowledge can help us improve the accuracy of weather forecasts. The assembly, designed and constructed for the Navy by New Mexico State University, is essentially a Nike-Cajun combination with the addition of a special instrument head or nose cone housing two 16-mm movie cameras especially designed by the Naval Research Laboratory. Two months ago the Navy, using a Terrier missile-type launcher, sent this rocket to an altitude of 86 miles where clear pictures were made of 700 miles of frontal cloud formation. For the first time, man was able to see such a vast cloud formation from above. Signals emitted by the nose cone's miniature transmitter made it easy for a surface ship and an aircraft with portable equipment to track the nose cone and recover it from the sea without undue difficulty.

The drawback to rockets, however, is that they only stay up for a few minutes. Satellites stay up for extended periods of time but, aside from the fact they are quite expensive to launch, they must stay above 100 miles to remain in orbit. Research cannot neglect the thin atmosphere well below 100 miles through which aircraft and many missiles will fly for some time to come, and through which we must move safely to reach outer space. High altitude balloons are the best currently available means for permitting both instruments and men to explore this area for extended lengths of time. For example, a recent Navy manned balloon flight remained aloft for a record of more than 34 hours, and a new type of superpressure balloon remained at peak altitude for 4 days in an initial unmanned flight and is expected to exceed that time in later flights. One product of the balloon projects of interest to communications people is the set of sun pictures taken through a telescope at 81,000 feet. Astronomers and physicists hope through them to be able to better understand flares, sunspots, and magnetic storms.

Turning more specifically to the field of electronics, the Navy is intensely interested in supporting such work as the development of millimeter wave apparatus and techniques, which have proved themselves to be extraordinarily versatile as research tools. They have enabled us to deal with many problems of microwave spectroscopy, solid-state physics, and gaseous electronics. They have permitted us to probe more deeply into atomic and molecular structure and other parts of physical science, which will ultimately improve our knowledge of the basic composition of matter.

INSIGHT MAY BREAK BOTTLENECK

Aside from the broader implications of gaining such knowledge, this research has given us much-needed insight into our study of electronic circuit elements. This, in turn, can break the bottleneck in the development of advanced military equipment where we are presently blocked by our lack of knowledge about materials that

might be used in the circuits of these equipments. Through millimeter wave research, we also expect to achieve a bonanza in our constant drive toward increased miniaturization and reliability since millimeter components are lightweight, small, and can be made shock-absorbent and reliable.

Another approach to achieving miniaturization and reliability, which are our major twin goals in electronics R&D, is through research in solid-state physics. For example, solid-state diffusion studies provided invaluable information which aided in the recent breakthrough in transistor fabrication that now permits the production of relatively economical, reliable, high-frequency transistors.

Electronics engineers are quick to take advantage of such achievements. During the past year, the University of Illinois, under joint ONR–AEC (Atomic Energy Commission) sponsorship, completed a detailed design study of a completely new, transistorized, very high-speed computer. When completed in 1960, it will be the fastest general-purpose computer in existence—about 100 times faster than present-day commercially available computers. The essential difference between this computer and others now in the planning stage is the very sophisticated and logical structure used. The machine is designed to be constructed from standard components, including transistors and magnetic cores.

The Navy is also willing to give support to such bold concepts as the first computer-like system capable of perceiving, recognizing, and identifying its surroundings without any human training or control. This concept, known as the Perceptron, has already been successfully simulated on an IBM *704* computer. Unlike conventional computer systems which draw on data fed into them and stored, the Perceptron has been conceived as a model of the biological brain, receiving visual images through an optical device somewhat similar to a television camera. The Perceptron has the proved inherent capability not only of learning what it is shown, but also of teaching itself to recognize something it has never seen before. A pilot model will be completed within a year.

Admittedly, the concept of this system is still in its infancy, and its basic theory must be extended. However, such further steps as the development of sensing devices suitable for providing visual and auditory inputs to the system would eventually make it possible for the Perceptron to read print and script, respond to human commands, and to translate printed text and oral speech.

At the same time, more orthodox research is supported at a steady pace, such as fundamental studies in electron ballistics or the interaction among streams of particles and electromagnetic waves. We can be sure that from the knowledge derived from this research will come improvements in the performance of electron tubes used in advanced radar and other electronics systems. As an example, during the past year klystrons, magnetrons, and other types of velocity-modulated tubes have been evolved with desirable characteristics of high power and relatively wide-frequency tuning capability. Such wide-band operation is of importance to variable-frequency radars and jammers.

BOTH MILITARY AND INDUSTRIAL SUPPORT NEEDED

As I POINTED OUT EARLIER, the over-all goal of basic research is to provide a well-stocked warehouse of fundamental knowledge from which new ideas can be drawn steadily for a variety of developments. This can only be accomplished if there is strong support from both military and industry sources.

There is no question but that private industry recognizes the need for basic research. According to a National Science Foundation (NSF) survey of 200 large corporations in 1953 and 1954, about one fifth of the companies indicated that they had actually experienced problems because of a lack of basic information in the conduct of their R&D programs. In such science-based industries as aircraft, scientific instruments, chemicals, and electrical equipment, at least a third of the companies interviewed reported a need for additional scientific knowledge. I know that electronics manufacturers in particular were among the first in industry to see the problem. They saw they could not long continue to provide new products and improved services for their customers, both civilian and military, unless their engineering laboratories were constantly fed the fundamental information, theoretical and experimental, needed to stimulate new discoveries.

The NSF survey discovered that there is a widespread feeling in industry that it is up to the Federal Government to support more basic research. However, some officials suggested that industry itself needs to carry on more basic research as well as to sponsor more in universities. These are obviously enlightened men. Perhaps such men are aware that the few companies which have established strong basic research programs have become the unassailable leaders in their field.

The President, in his recent budget presentation, noted that funds for basic research by all Government activities are continuing to increase. He announced that "for all agencies combined, it is estimated that Federal expenditures for basic research will be about $500 million in fiscal year 1960." If industry will also increase its allocation of uncommitted funds for pure research, then I believe this Nation will have a basic science effort that we can be sure is unequalled anywhere else.

RE-EXAMINE EDUCATIONAL SYSTEM

MORE MONEY, however, is only part of the problem. This country also requires a greater supply of scientific brains. Here the problem is more complicated because we must start with our youth. We must re-examine our educational system and see to it that it is properly geared to bring out and mature the scientific talents and skills our youngsters have inherited. There must be organized efforts to make certain that those with better-than-average abilities, but not necessarily in the genius class, have a full opportunity to develop their capabilities. Many boys and girls have latent abilities

that do not become apparent until they are drawn out and encouraged by skillful teachers. As you are aware, we need more such teachers, and we must pay to get them.

When a promising student is ready for college, he or she should be given at least partial financial support, where required, through scholarships or other means of subsidization. The sums given, if carefully planned, need not be enormous but should provide support for the student throughout his course of study. The Navy, through its basic research program, has helped a number of advanced and graduate students during the more than 10 years of its operation. Something like 50 per cent of all Ph.D.'s in the physical sciences have been partially supported by Navy research projects.

Money and brains provide the basic essentials, but there is still something else needed. Since a basic research program is geared to a future we can only see dimly, it requires careful long-range planning with a built-in flexibility to adjust to unexpected contingencies, both good and bad. This can be a frustrating task, and it requires a lot more than a few inspiring words.

It is easy enough to construct a broad general plan that aims at an ideal goal. But, when it comes to working out practical action and realistic details as to exactly what work will solve what problems, then the picture is not so clear and simple. Some of the elements of the plan of basic research cannot be undertaken for want of the right man or the right base from which to start at any given time. When the results begin to come in, it will be seen that some work is unsuccessful, and some research will take longer than anticipated. Overall, no broad, sweeping, perfect plan can be carried out neatly.

BOLDNESS AND FAITH NECESSARY

ALSO, WE SEEM TO HAVE DISSIPATED the heritage of our Yankee forefathers and the early pioneers who converted their bold visions into reality by being willing to stick their necks out and to take aggressive calculated risks. Just as they did, we too face new frontiers with only limited experience to guide us across them. They did not hesitate then; it would be disgraceful to hesitate now.

Finally, we must have the impetus that comes from faith in the potentialities of the unfettered human mind, faith in our own unhampered intellect. The modern scientist has this faith. He knows without question that if he can search long enough and hard enough, he will keep finding more pieces of knowledge to fit into nature's puzzle, thereby giving man greater control of his life and environment. The biblical scorn showered on "ye men of little faith" is earned by too many Americans today who would be better off if they could be imbued with the faith that pervades the scientific mind. This is the faith that indeed moves mountains and accomplishes modern miracles.

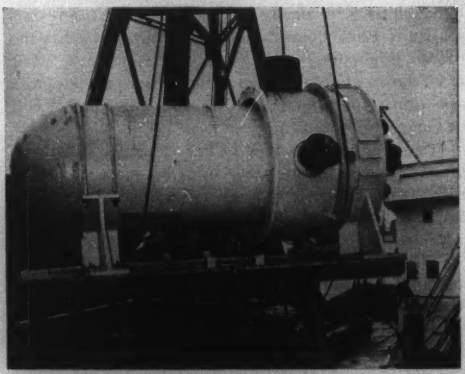
As I indicated before, scientific supremacy is an elusive, almost imaginary goal which we can never be sure we have attained. This does not mean that we should not continue to strive for it. For one thing, it serves as an incentive which is badly needed to remind the American public that upon superior scientific research depends not only their immediate future, but also the future of generations hence.

Our present national security and our security for an indefinite period ahead is based largely on technological skills developed through science. The greater the capability of our scientific instruments to detect an attack in advance and the greater our means of instantly responding with terrible and accurate destruction, the more we can feel safe that no one will plan violent aggression against us.

However, this is by no means the principal goal of science. The major contribution of this use of scientific research is that it establishes peace. We require peace over a period of many decades to give us the time to lay the foundation of new knowledge which can help build a new world for man, a world in which the principles of American democracy and freedom can predominate. This could be a world in which science will have united mankind in attempts to travel to the stars and beyond.

By that time, the goal of man will no doubt be to achieve scientific mastery over the universe. Will man eventually reach that goal? Let me put this question in another way. Will man finally obtain the ultimate answer to the riddle of his existence?

A-Plant Component Shipped



Reactor pressure vessel for Belgium's first nuclear, 11,500-kw power station was manufactured by Babcock and Wilcox for Westinghouse. The core of the pressurized water reactor for this plant consists of stainless steel tubes containing uranium oxide pellets.

The power station is being constructed at Mol, Belgium, by the Centre d'Etude de l'Energie Nucleaire.

A Mobile Vibration Laboratory for Overhead Lines

J. R. RUHLMAN
ASSOCIATE MEMBER AIEE

J. C. POFFENBERGER
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S. GROSSHANDLER
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MOUNTING REQUIREMENTS for capital investment and dependability per circuit-mile of transmission construction have given imminent importance to the elimination of incipient fatigue failures of overhead conductors and associated hardware. The increasing attention devoted to these fatigue problems in recent years has been manifested by the expansion of both laboratory and field activity in cable vibration research and in the development of improved test methods and equipment for obtaining pertinent data. However, relatively few field investigations to date have utilized the modern instrumentation techniques common to the laboratory, and those studies have been confined to nonenergized test spans since the transducers employed in modern instrumentation require electric connections to grounded recording equipment. The mechanical instruments used in energized line studies have been entirely inadequate for accurately measuring the many pertinent variables involved. Consequently, there are insufficient field data to establish quantitative relationships or to permit realistic correlation with laboratory results.

In order to accumulate representative and comprehensive field data from a variety of environments, a mobile vibration laboratory, termed mobile Dynalab, has been designed and constructed. This unit, shown in Fig. 1, is suitable for extended operations in any geographical region of the United States and contains an advanced instrumentation system capable of determining the frequency, stress distribution, elastic curve, and temperature of a vibrating conductor. In addition, the system permits measurement of wind velocity, barometric pressure, humidity, ambient temperature, as well as other variables associated with the vibratory action of the cable and the mechanism of excitation. Provision has been made for the transduced signals to be selected, programmed, and recorded in such a manner that data reduction and subsequent analysis will be facilitated. The system comprises the following major components:

1. Transducers for sensing physical phenomena and converting the information into electrical signals.
2. Signal transmitting system.
3. Amplification stage.
4. Detecting–discriminating system for monitoring the signals and comparing them with preselected reference levels.
5. Programming system for arranging the signals in a predetermined pattern and sequence for recording.
6. Recording system for converting the electrical signals into visible traces on a permanent record.
7. Analvzing system for reducing and evaluating the data obtained.

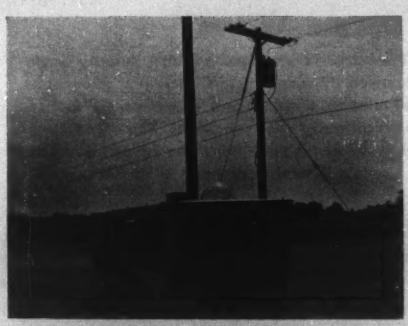

Fig. 1. Mobile Dynalab at a field site. Distribution line supplies necessary power for equipment.

Because the scope of realistic field research has been limited by the absence of a method for securing accurate data from energized lines, a pilot model telemetering system was constructed specifically to determine the feasibility of transmitting physical data by radio communication. A transistorized, battery-powered, FM transmitter of original design, a commercial receiver, and a "pen-writing" oscillograph were incorporated in the system. In high-voltage tests of the telemetering equipment at Oregon State College, Corvallis, Ore., signals from an accelerometer mounted on a vibrating test conductor energized at a voltage equivalent to 345-kv phase-to-phase were transmitted, received, and recorded. This represented the first known telemetered transmission of vibration data from an energized specimen and demonstrated the feasibility of using telemetering techniques in field vibration research.

A long-term program of closely co-ordinated laboratory and field experimentation on overhead line vibration problems has been initiated, and it is anticipated that telemetering equipment will be incorporated in the mobile Dynalab to complement the existing instrumentation. It is intended that the knowledge gained in the program will ultimately form a practical basis for evaluating existing construction practices, improving hardware and structure designs, and establishing allowable tensions that may be safely used in various environments. The experimentation program was founded on the premise that a combined approach by an integrated utility-manufacturer team is the optimum method of attacking a complex problem of mutual interest.

Digest of paper 59-105, "A Mobile Vibration Laboratory Unit for Monitoring Dynamic Characteristics of Overhead Transmission Lines," recommended by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959.

J. R. Ruhlman, J. C. Poffenberger, and S. Grosshandler are with the Preformed Line Products Company, Cleveland, Ohio.

The Outlook on Science in Canada and England

B. G. BALLARD
FELLOW AIEE

The scientific structure of any country is influenced by many factors, including geography, population density, and resources, as well as political and social conditions. The organization of scientific research which has evolved in Canada and England is discussed.

SCIENCE now plays such an important role in the social and economic progress of any country, to say nothing of national security, that it is not surprising that each country should undertake a searching study of its own scientific structure as well as a critical examination of the corresponding structure in other countries. It is not to be expected, or even desired, that science should develop in the same manner in all countries. Despite its universal character, the needs and inclinations of individual countries vary widely. The individual scientific organization is influenced by the geography, population density, type of resources, ease of communication, and finally, both political and social conditions.

History often provides the reason for the various approaches to science in different countries. For example, in the 19th Century, research in England was conducted largely by universities, philosophical people of means, and very often sponsored by such organizations as the Royal Society and the Royal Institution of London. As the scientific record of England attests, very excellent results emerged, probably because only the more inspired persons were prepared to devote time and money to satisfy their urge to learn the secrets of nature. However, the emphasis was confined mainly to fundamental science. On the other hand, in continental Europe, and especially Germany, science received government support, and notable advances were made not only in pure science, but even more importantly, in applied science. Progress in the latter was largely responsible for the highly competitive position which Germany enjoyed in international markets. As a consequence, England in 1917 created a Department of Scientific and Industrial Research which has promoted both pure and applied research and which has affected profoundly the scientific climate of the country.

In the New World, the sheer necessity of wresting a living from a relatively undeveloped area precluded until recent years the more leisurely approach to science, but even so, the United States in particular began to devote increasing attention to science, and notable scientists such as Joseph Henry emerged.

Full text of a conference paper presented at the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959, at a session sponsored by the AIEE Research and Management Committees.

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SCIENCE IN CANADA

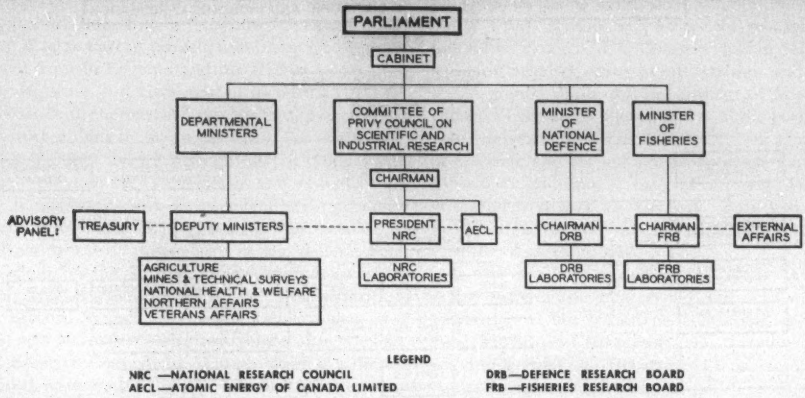
DURING WORLD WAR I, Canada undertook a survey of her scientific resources and found them pathetically inadequate. She studied the scientific organization in Great Britain and copied what she considered was desirable, and innovated where she felt that the British system was not applicable to her needs. It is important to note that both systems have emphasized the desirability of freedom from political pressure, and although they have evolved along somewhat different lines, both have made provision for policy and guidance from an independent body of men who are not on the government payroll.

In a general way, research is undertaken by four separate types of institution:

1. Government organizations
2. Universities
3. Industry
4. Privately endowed organizations

In the first two, practically all the financial support comes from the government, and even much of the industrial research is financed by government contract. The government, therefore, wields a very important influence on the scientific life of a country, and its outlook deserves the closest scrutiny.

While England created a department of science, Canada avoided this approach. Her major civilian scientific body, the National Research Council, is not a government department and is free of many of the restrictions which are normally imposed on government departments. Obviously, the government must exercise some control because the National Research Council operates mainly on public monies, but the scientific policy is laid down by an independent civilian body which serves without remuneration, and which is recruited from the outstanding scientists across the country. These scientists are mainly from the universities, but there are also scientists from industry and other organizations. The Council reports not to a Minister as such, but to a Cabinet committee known as the Committee of the Privy Council on Scientific and Industrial Research, the Chairman of which presents Council's estimates to Parliament. Not only does the Council, a body of 21 men of whom four are permanent



Organization of Science in Canada*

staff, determine the scientific policy to be followed, but also, subject to approval of the Chairman of the Privy Council Committee, it is responsible for the selection of staff and even the budget. Naturally, however, there must be a mutual agreement between Council and Cabinet in arriving at each annual budget. Thus, the Council can freely recruit staff for its laboratories, and it also largely controls its own purchasing. This is particularly important in the award of development contracts.

It should be emphasized that the National Research Council not only operates its own laboratories, but also is the major federal body responsible for aid to universities for research. Thus, it discharges the obligations of such bodies in the United States as the National Bureau of Standards and the National Science Foundation.

In a general way, the purpose of the National Research Council is to encourage and foster research in Canada. The Council believes that one of its most important duties is the support of university research and the training of a highly qualified research staff. The laboratories of the Research Council have provided a most impressive stimulant in developing research in the universities and, rather than being regarded as competitors of the universities, they are a complement.

The National Research Council supports both fundamental and applied research in universities and in its own laboratories. While some of the applied research is speculative in nature, in the main it is directed toward the needs of industry, and the Council undertakes development and investigations for industry on a cost-plus basis.

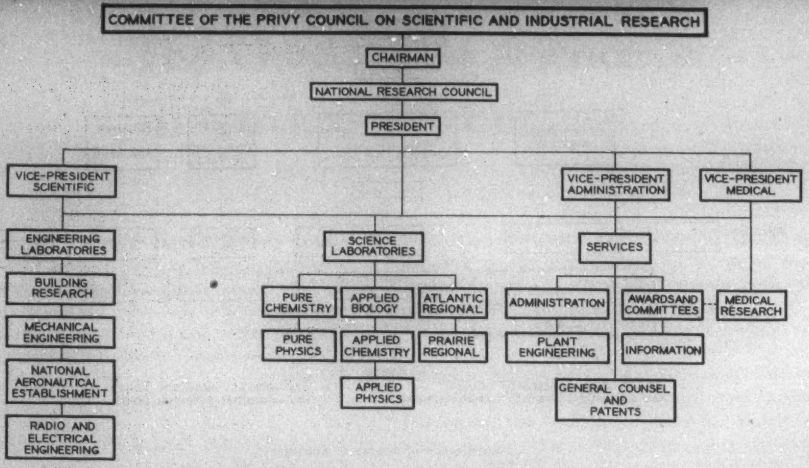
The laboratories of the Council embrace pure and applied physics, pure and applied chemistry, applied biology, mechanical engineering, aeronautics, building research, and radio and electrical engineering. The Council does not operate medical research laboratories, but it does support medical research in universities and other institutions, and one of its three vice-presidents has his main responsibility in the field of medical research.

In all advanced countries, science has invaded government activities extensively, and most departments in the Canadian government have created laboratories to assist them in meeting the responsibilities with which they are charged. Because of the very intimate responsibility of each government department for scientific developments in its own field, it has never been felt that the scientific work of the various departments should be consolidated in a single laboratory. Despite the fact that they are engaged mainly on practical problems, some departments do undertake fundamental work. This is particularly true of the Department of Agriculture which, under its Science Service Division, maintains laboratories devoted to bacteriology, botany and plant pathology, chemistry, entomology, and forest biology. The Department of Mines and Technical Surveys also operates extensive laboratories under its Mines Branch, and the Dominion Observatory has contributed some notable work in the field of astronomy. It should be clearly understood that other government departments are also making valuable contributions in science, but it is not the purpose of this article to outline in detail the actual work in progress.

While the various government departments enjoy relative freedom in the operation of their laboratories, an advisory panel, consisting of the Deputy Ministers of those government departments most actively engaged in science, has been created to co-ordinate and give guidance where necessary. The Chairman of this committee is the president of the National Research Council.

As in other countries, defense plays a very important part in the scientific life. At the outbreak of World War II, Canada had few well-established defense laboratories and, since the National Research Council had by that time relatively comprehensive laboratory facilities in

*Advisory panel comprises Deputy Ministers of the Departments involved and Heads of the other government agencies involved.



Organization of the National Research Council in Canada

the more important fields, the government declared it to be the official defense laboratory for all the Services, a duty it discharged until the end of the war. The consequence of this responsibility was that the Research Council devoted its efforts almost exclusively to defense during the war, and, of necessity, neglected those responsibilities for which it was originally created. At the close of the war it became increasingly evident that it would not be possible to serve in a dual capacity, and it was agreed that a new defense research body should be created which would provide scientific facilities for the Armed Services of the country. This was known as the Defence Research Board, and it has developed a comprehensive and very effective research organization with laboratories in various parts of the country. It engages in both pure and applied research, although the former is confined mainly to those projects which are likely to have a defense significance. The Board also operates a number of environmental laboratories.

However, since its purpose was directed toward a definite goal, and since the Department of National Defence must obviously have control over the research undertaken, the constitution of the Defence Research Board differed somewhat from that of the National Research Council. It was created within the framework of the Department of National Defence and, thus, is a government department. As in the case of the National Research Council, it has an advisory board, some of whom are recruited from civilian scientists across the country. Representatives of the three Armed Services also serve on the Board and there is a rather higher percentage of ex officio members than in the National Research Council. The Defence Research Board recruits its staff in much the same manner as the National Research Council, but its purchasing is administered through the normal government channels.

As indicated earlier, the universities derive their main research support from government sources, the most important of these being the National Research Council. The Atomic Energy Control Board also makes grants in aid of research which are administered by the National Research Council, and the Defence Research Board makes a further important contribution in this field. All three organizations support both pure and applied research. The Defence Research Board, in particular, awards development contracts to universities, but this practice is not so common as in the United States.

One form of assistance which has been offered by the Research Council in addition to scholarships and grants in aid of research is the placement of postdoctorate fellows in the universities at the expense of the Research Council. This has proved to be a very effective stimulant, and is one which the universities appreciate particularly.

In making grants in aid of research to universities, the National Research Council operates in a manner very similar to that of the National Science Foundation in the United States. However, because of the smaller scale of operation, it is possible to have one body of men make the final assessment of all awards, and a satisfactory relative rating can be preserved. This rating is undertaken by the members of the National Research Council itself, although they are assisted in the work by other groups, some within the government service, and some without, who collect and provide supporting data and information. While the present per capita support for research in Canadian universities compares favorably with that in the United States, the projected support for the future in the United States appears to be somewhat more generous.

Industrial research in Canada occupies a rather dif-

ferent position from that in the United States or Great Britain. A large part of Canadian industry is subsidiary to parent firms in England and the United States, and, as a consequence, it derives most of its research and development from the parent firms. Indeed, much of the design work is done by the parent firms. For this reason, the research effort in Canadian industry is rather small, although the pattern is changing, and Canadian industry is becoming more independent. This tendency has been encouraged by government contracts which have been awarded, particularly in the defense field, and some industries have developed equipment which can be marketed competitively in the United States and Great Britain. As indicated earlier, industry may, if it wishes, seek assistance from the laboratories of the National Research Council. In addition, there is a limited amount of co-operative research in industry in the form of research associations for a particular segment, but this practice has not developed as extensively as in Great Britain.

While the bulk of civilian research is guided by the National Research Council, some Canadian provinces have found it desirable to create local councils which operate somewhat after the pattern of the federal organization. Their effort is devoted mainly to applied research or development to meet the particular needs of the individual province, but they also engage to a limited extent in fundamental research, and in some cases receive financial support from the National Research Council to pursue their fundamental research. Some of these provincial bodies are self-supporting; that is, they collect sufficient revenue from industry to finance their development program. There are practically no privately endowed research institutions in Canada.

SCIENCE IN ENGLAND

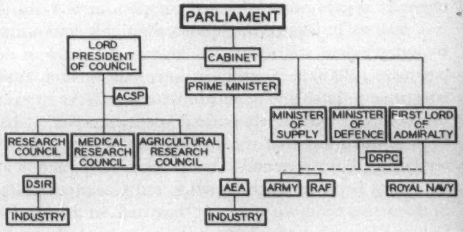
ENGLAND has a reputation for "muddling through," but in her muddling she seems to achieve an extraordinary degree of success. England is also a country of powerful tradition and, however loose or improbable the original concept may have been, she seems to make her system operate successfully.

One apparent difference between the Canadian scene and that in Great Britain is the very active interest which the Cabinet takes in science in England as compared with Canada. In an earlier day, the chief source of executive power in Great Britain was the Privy Council. The Privy Council office is still in existence and is presided over by a senior Cabinet member, the Lord President of the Council who is regarded as being the Cabinet member in charge of scientific matters, although this is not an exclusive responsibility. The Department of Scientific and Industrial Research, which was created in 1916, reports through an executive council known as the Research Council, and this, in addition to the Medical Research Council and the Agricultural Research Council, reports to the Lord President of the Council. The Research Councils comprise independent scientists who give advice on the policy which should be pursued in relation to each individual Council. The Councils operate laboratories, maintain research units at universities, and make research grants. While the Department of Scientific and Industrial Research operates on a direct parliamentary vote, the other two Councils operate from a grant in aid of research, and are not subject to direct departmental control. In addition, at the end of World War II, the government created an Advisory Council on Scientific Policy to advise the Lord President on his various scientific responsibilities.

It will thus be seen that, as in Canada, much of the policy for scientific matters is determined not by government staff but by independent scientists. Even the National Physical Laboratory, which obtains its operating funds from the Department of Scientific and Industrial Research, derives its policy from the Royal Society of Great Britain.

So far, we have been discussing civilian research. Defense research is under a more rigid government control, and the Minister of Defence, acting on the advice of the Defence Research Policy Committee, is directly responsible for defense policy. It should be clearly understood that the Defence Research Policy Committee is also a body of independent scientists and there may be, in some cases, a common membership between the Defense Research Policy Committee and the Advisory Council on Scientific Policy. It is important to note also that defense research matters do not fall within the purview of the Lord President of the Council. No one can accuse the British of being consistent. Admiralty assumes responsibility for all research and development associated with the Navy. On the other hand, research and development for the Army and Air Force is the responsibility of the Ministry of Supply, and this department operates extensive laboratories.

Atomic energy, of course, occupies an important place in the British scheme, and prior to 1957 the Lord President of the Council was responsible to parliament for general policy in this field. In that year, however, the responsibility was transferred to the Prime Minister.



LEGEND
ACSP —ADVISORY COUNCIL ON SCIENTIFIC POLICY
DSIR —DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
AEA —ATOMIC ENERGY AUTHORITY
RAF —ROYAL AIR FORCE
DRPC—DEFENCE RESEARCH POLICY COMMITTEE

Organization of Science in Great Britain

Research in this field is carried out mainly by the Atomic Energy Authority with collaboration by industry.

Because there is a Ministry of Education in Great Britain, the support of university research differs widely from that found in Canada. Whereas the three Research Councils in Great Britain are concerned with research in the universities, the main source of support is through a government University Grants Committee, the members of which are appointed by the Chancellor of the Exchequer. There is no direct departmental control of the financial aid to universities for research. About 70 per cent of the universities' income is derived from this source. A number of British universities are already generously endowed from private sources. Some of them have been endowed with property, not as real estate for physical structure, but as an investment. The real returns from these investments have not declined with inflation.

Private industry maintains a very active research policy, and its support of fundamental research is particularly noteworthy. The Associated Electrical Industries Laboratories, for example, confine themselves entirely to pure research, and the moment a project begins to look useful, they cease work on it and turn it over to the factory for development. Private industry has created extensive laboratory systems not only in industrial plants, but through co-operative research associations of which the British Electrical and Allied Industries Research Association is a notable example. The research associations occupy a prominent position in the scientific life in England, particularly on the development side, but they also conduct some fundamental research.

Private individuals and private societies such as the Royal Society have traditionally occupied an important position in the scientific community. The contributions from these sources cannot be overemphasized. On the other hand, there are few privately endowed research organizations in England comparable with those in the United States.

CONCLUSION

One common feature of both Canadian and British scientific organizations devoted to speculative research is a zealous insistence that policy shall be determined by independent scientists and not by a government department. Perhaps Canada has veered farther from government department control than has Great Britain, but both rely extensively on independent advice. It has been pointed out that the British Cabinet is aided directly by advisory committees on scientific policy. The difference between English policy and Canadian policy in this respect is more apparent than real. In the former, Cabinet is appraised of the policy views of the independent scientists before the budget is introduced, whereas in Canada the government charges the independent bodies with the responsibility for outlining policy which is then discussed at the time the annual budget is prepared. The National Research Council has frequent discussions with the chairman of the Committee of the Privy Council on Scientific and Industrial Research. Government departments, including the Defence Research Board, are in frequent consultation with their respective ministers so that the Cabinet is kept well informed on the thinking of all bodies concerned with scientific policy.

One important aspect which has not been mentioned previously is that in Great Britain scientific bodies operate on a projected 5-year budget in order to provide greater stability and permit longer-term planning. This does not mean, of course, that organizations are committed to a budget determined 5 years previously, but they are enabled to forecast the minimum support they can expect for a period 5 years in advance. Incidentally, the 5-year budget applies also to university support. In Canada, the budget is prepared on an annual basis, although the National Research Council has an internal 5-year plan which is discussed informally with Treasury officials.

Another important feature of policy common to both British and Canadian scientific organizations is the attitude toward staff appointments. Both bodies have felt that special provision should be made for recruiting and maintaining staff. In England, a special Scientific Civil Service has been created which is distinct from the conventional Civil Service and which provides a salary scale and a selection scheme which is considered to be appropriate for scientific staff. In Canada, a similar end has been achieved by recruiting staff for the National Research Council and the Defence Research Board not through the Civil Service, but through the independent boards under which they operate. It is generally recognized that the National Research Council and the Defence Research Board system for recruiting and maintaining staff has operated very effectively.

It has been indicated that history affects the development of science in all countries. Just as political thinking varies, so does the organization of science, and it is not possible to adjust political thinking in any country to agree with the philosophy which may appear to be effective elsewhere. Weaknesses can be detected in most scientific organizations, and the Canadian organization is no exception. Nevertheless, the present trend is encouraging. Industrial research, which for long had lagged, is beginning to develop, and there is an increasing respect for creative minds throughout the country. Too often, physical achievement and the material things of life have been held in higher regard than intellectual achievement. No science, regardless of how well it is organized, can survive without creative minds.

Effect of Operating Frequency on Missile Alternators

R. E. TURKINGTON

MEMBER AIEE

THE EXTENSIVE USE of 400-cps power systems in manned military aircraft and the consequent availability of standard 400-cps generation, conversion, and utilization components has caused this frequency to be used in most U. S. guided missiles. However, as higher missile flight speeds, longer ranges, and greater accelerations are needed to achieve successful guided-missile missions, the adoption of all measures that reduce the weight and volume of the electric power system without impairing reliability and logistics must be considered. Use of a power frequency higher than 400 cps would permit substantial reductions in the weight and volume of most missile electromagnetic components and of the prime energy source. However, the determination of an optimum missile power frequency must include a coordinated study of the generation, conversion, transmission, and utilization of electric power in missiles. This study shows that higher power frequencies are compatible with missile utilization components and that the weight of signal transformers and magnetic amplifiers may be decreased substantially.

Results of the model-theory analysis of power transformers and alternators are shown in Figs. 1 and 2. Unity relative weight is shown for 400-cps units. For the alternator curves of Fig. 2, the number of poles is assumed constant. (Weight is nearly independent of the number of poles when the shaft speed is constant and the number of poles is less than 12.) In addition,

1. The winding loss of each device decreases with increasing frequency when the winding temperature is assumed constant.

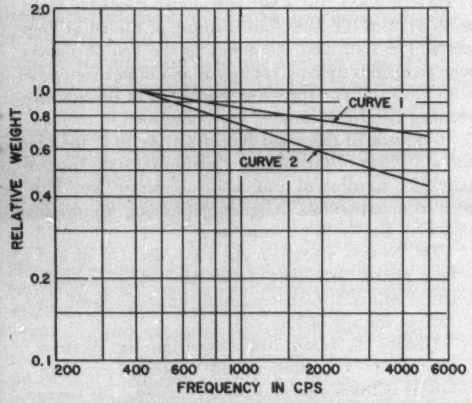


Fig. 1. Relative weight of transformers as a function of frequency. (Curve 1—Convectively cooled. Curve 2—Conductively cooled.)

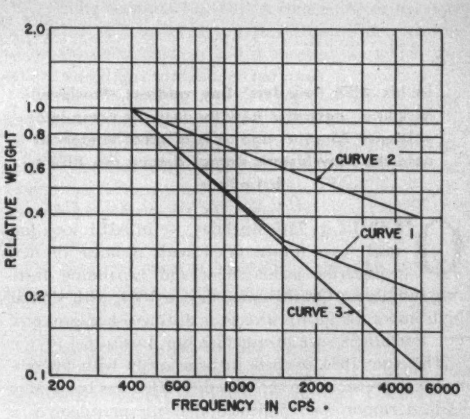


Fig. 2. Relative weight of alternators as a function of frequency. (Curve 1—Wound-field synchronous alternator. Curve 2—Permanent-magnet alternator. Curve 3—Induction alternator.)

2. The core loss decreases with increasing frequency when the core temperature is maintained constant.

3. The winding leakage reactance increases with frequency if constant core temperature must be maintained. If an increase in temperature is permissible, the reactance is nearly constant.

4. The volt-ampere excitation required by the transformer core decreases with increasing frequency.

Reductions in the weight of missile alternators and transformers that can be achieved by the use of a power frequency higher than 400 cps usually represent a significant fraction of the total electric power supply weight. Use of a higher power frequency also can result in decreased weight of the prime power source, defined here as the prime energy source (solid or liquid fuel or pressurized gas) and a partial-admission turbine. Turbine efficiency is approximately proportional to turbine tip speed over a wide range of speed. Therefore, the higher alternator speeds that can be used with higher frequencies permit a decrease in the weight of the fuel-turbine system.

Digest of paper 58-772, "Effect of Operating Frequency on the Weight and Other Characteristics of Missile Alternators and Transformers," recommended by the AIEE Air Transportation Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting and Air Transportation Conference, Buffalo, N. Y., June 22-27, 1958. Published in AIEE *Applications and Industry*, Nov. 1958, pp. 289-300.

R. E. Turkington, now with the Radio Corporation of America, Waltham, Mass., was formerly with the Massachusetts Institute of Technology, Cambridge, Mass.

The Institute: Formed 75 Years Ago Today

L. F. HICKERNELL
AIEE PRESIDENT

In his AIEE Founders' Day address, President Hickernell describes how the Institute came into existence 75 years ago. It is of great interest to note the now-historic names among the AIEE's first officers.

ON THIS, its 75th Birthday, we in AIEE look forward to a future filled with promise of new engineering achievement and expanding Institute usefulness. On this same day in 1884, with similar high hopes for future success, a distinguished group of our forefathers met to organize our Institute.

The year 1884 opened inauspiciously with an economic depression. On the very day AIEE was born, May 13th, a rumor was confirmed that the president of a New York City bank was defaulting to over $3 million, most of it lost in Wall Street speculation. The bank's directors promptly came to the rescue and enabled it to resume business the next morning, but the shock of this enormous defalcation precipitated a panic. On the morning of May 14th, a run on the Metropolitan National Bank compelled it to close its doors before noon. The stock market opened to intense excitement. Stocks dropped drastically. Even Western Union fell from 88 to 49. Banks refused to loan, even on Government bonds as collateral. Money commanded 3% per day commission and interest. By the end of May, confidence in banks at least, was restored.

Also in 1884, an International Conference adopted the Greenwich meridian. Pasteur announced his inoculation against rabies. This was the year that the Statue of Liberty was presented to the American Minister in Paris, and that the Washington Monument was completed at a total cost of $1,187,710.31. The Federal Government, with receipts of $333 million and expenses of $254 million, ended the year with a surplus of $79 million.

So much for the state of the Union 75 years ago. What was the state of the electrical industry in the United States? Well, commercial telegraphy had been in use for 40 years, and the Atlantic Cable for 18. Commercial telephony was 7 years old; arc lighting, 5. Edison's incandescent lighting central station on Pearl Street in New York City had been operative for a year and a half. Electric railroads and street cars were still in the experimental stage.

In 1883, the first photographs by incandescent lamps were made at Menlo Park, N. J. The same year, Edison discovered that electric current can flow through space, from a filament to a plate in an incandescent lamp. This discovery laid the foundation for modern electronics. Also in 1883, the first night baseball game was played—at Fort Wayne, Ind.

Gaulard and Gibbs invented an a-c system of distribution in 1881. Sir William Crookes demonstrated the properties of cathode rays in 1878. Prof. Elihu Thomson, during a lecture in 1877, immersed a coil of German silver wire in water, and boiled some eggs.

Emile Berliner invented the microphone in 1876. Weston used an electric arc furnace for the first time in 1875. Also in 1875, right here in New York, Samuel F. O'Reilly operated the first electric tattooing machine. This epic event took place in the Bowery.

Seriously, developments were rife in the field of electricity in 1884. Many inventions awaited further development for commercial application. "The Age of Electricity" had begun, and the organization of an electrical engineering society was overdue.

Most organizations come into existence through the initiative and aggressiveness of one man, aided by a group of farsighted associates. Our Institute is no exception. Nathaniel S. Keith was AIEE's Founder. Born in Boston, Mass., in 1838, he was educated as a chemist in his father's laboratory in New York City, and practiced as an electrometallurgical engineer most of his life. In 1870, and for many years after, he was engaged in electrical work as an inventor, writer, and electrical engineer. He died in 1925 at the age of 87.

Early in 1884, Dr. Keith circulated a call for signatures to form the American Institute of Electrical Engineers. The Call, and the names of the first 56 signers, who were "electricians, capitalists and others connected with electrical enterprises or interested in the advancement of electrical science," were published in the April 5, 1884, issue of *Electrical World*. Dr. Keith at the time was a member of the magazine's editorial staff. Incidentally, it is startling to come upon the word "capitalist" used as a respectable designation. Among the original signers of Dr. Keith's circular were:

DR. NORVIN GREEN, a physician. Dr. Green had been elected president of Western Union in 1878, and continued in that position until his death in 1893 at the age of 75.

GEORGE A. HAMILTON, electrician for Western Union. Mr. Hamilton joined Western Electric in

Full text of an address presented at the AIEE Founders' Day Luncheon, Hotel Astor, New York, N. Y., May 13, 1959.

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1889, an association which continued until his retirement in 1909. He became the Institute's Treasurer in 1895, and remained in the post until 1930, a period of 35 years! Of the original officers, Hamilton was the only one still on hand to celebrate our 50th Anniversary in 1934. He died the following year, at the age of 92. (It is interesting to note that our Founders were rugged individuals, many of whom lived to an age well above the average in the present day, when greater longevity is accepted as a comparatively new development.)

STEPHEN D. FIELD was another of the signers. He invented a rapid-speed stock ticker in 1884, and many other telegraphic devices. He was a nephew of Cyrus W. Field.

THOMAS A. EDISON affixed his signature, designating himself simply as "inventor."

The Call contained seven paragraphs, all well worth reading. It stated that "the rapidly growing art of producing and utilizing electricity has no assistance from any American national scientific society." There was no excuse for this, wrote Keith, except that it be "the short-sighted plea that everyone is too busy to give time to scientific, practical and social intercourse which other professions have found conducive to advancement."

This stern accusation would seem to indicate that the plea of "too busy" was used as frequently 75 years ago as it is today!

The Call pointed out than an International Electrical Exhibition to be held in Philadelphia, Pa., in the Fall of 1884 would attract many prominent foreigners concerned with electricity and its applications. Wrote Keith, "It would be a lasting disgrace if no American . . . society was in existence to receive them with . . . honors due . . . from their co-laborers in the United States."

Thus was proposed the organization of the American Institute of Electrical Engineers. Membership was to be open to "electrical engineers, electricians, instructors in electricity . . . inventors and manufacturers of electrical apparatus, officers of . . . all companies based upon electrical inventions, [and] . . . all who are inclined to support the organization for the common interest."

It was intended that the members would assemble and read and discuss papers and matters relating to their trades or professions, and at the same time to enjoy social relationships, all of which "is conducive to improvement and advancement in ideas, theories, practice, business, and good-fellowship."

Publication in book form of the papers, discussions, and transactions at meetings was proposed. This aim was fully accomplished, and we now have a permanent historical record of electrical science and engineering for 75 consecutive years published by the Institute.

Other purposes cited in the call were "affiliations with sister societies, a museum, library, original research, protection from unfavorable legislation, settlements of disputed electrical questions, exchanges of volumes of transactions with foreign and other . . . societies . . . etc., etc."

Considering that this was three quarters of a century ago, the ample list of proposed activities can only inspire admiration for the vision of a future that might require a double "etc."

A preliminary meeting of the signers was held in the rooms of the American Society of Civil Engineers on the evening of April 15, 1884. A committee of five was appointed to prepare a report including the scheme of organization, and to call a meeting at which the report would be heard, and acted upon.

On May 13, 1884, exactly 75 years ago today, a "large and enthusiastic meeting" was held. The Committee on Organization proposed a set of rules for the government of the Institute, which was read and adopted. The Committee nominated a slate of 21 officers, who were elected. Among the first officers were:

President

DR. NORVIN GREEN of New York City, who served 2 terms.

Vice-Presidents

ALEXANDER GRAHAM BELL, of Washington, D. C.

CHARLES R. CROSS, of Boston, head of the Physics Department at the Massachusetts Institute of Technology. Prof. Cross proposed and organized the first 4-year course in electrical engineering in 1882.

THOMAS A. EDISON

Directors

CHARLES F. BRUSH of Cleveland, Ohio, inventor of the Brush electric arc light.

STEPHEN D. FIELD, of New York City.

ELISHA GRAY, of Chicago, Ill., who claimed invention of the telephone. Gray engaged in a long and bitter patent infringement suit, eventually losing to Bell by decision of the U. S. Supreme Court. Gray, with E. M. Barton, organized the manufacturing concern of Gray & Barton, out of which evolved the Western Electric Company.

EDWARD WESTON, who established the first factory in the United States to manufacture dynamo-electric machinery. This was erected in Newark, N. J., in 1875. Weston invented the Weston cadmium cell, which was adopted by the International Electrotechnical Commission in 1908 as the official standard of electromotive force.

EDWIN J. HOUSTON, of Philadelphia, who with Elihu Thomson organized in 1883 the Thomson–Houston Electric Company, which was merged in 1892 with Edison's company to form the General Electric Company. Thomson was later to become President of AIEE (1889-90).

THEODORE N. VAIL, of Boston, who incorporated the American Telephone & Telegraph Company in 1885, and became its first president.

Having started its existence under the management of this distinguished and high-powered Board of Directors, it is not surprising that AIEE has grown and developed and flourished during the first 75 years of its life.

Electrical Intelligence and Power

A Trusteeship

W. P. MARSHALL

A review of electrical progress during the past 75 years. The rapid integration of electrical intelligence and power, which now has the resources of the atom at its disposal, can open up an era of peace and material satisfactions as the engineer's contribution to mankind's welfare.

THE American Institute of Electrical Engineers was founded in this City of New York 75 years ago this very day. From that moment, its members, whether they realized it or not, became the custodians of one of the greatest economic and socializing forces extant in the world today—electricity.

The record of your past transactions discloses how well the founders, and you who have succeeded them, have accounted for your stewardship. The sheer force which you have tamed has multiplied thousands of times the power of man's right arm. The lightning vibrations which you have put under precise control have projected man's intelligence—his mind and will—instantly to, and today beyond, the ends of the earth.

AIEE's twin concerns—for the generation and use of power, and for the communication of intelligence—can be traced from the very beginnings. I appreciate your kind invitation for me to help you celebrate your Diamond Jubilee. Telegraph engineers have had a strong interest in the AIEE throughout its 75 years and, as your program today notes, the first president of AIEE—Norvin Green—was also one of my predecessors in the presidency of Western Union.

Telegraphy was the first application of electricity to emerge from the physics laboratory and assume crucial importance in the conduct of this nation's and the world's affairs. It had been established as a going industry some 40 years when AIEE was formed. In 1884, by contrast, the first commercial telephone exchange, at New Haven, Conn., was only 6 years old. Edison's pioneering Pearl Street generating station had not yet celebrated its second anniversary. Under such circumstances, it is hardly surprising that, of the 25 men who signed the call to the original AIEE organization meeting of May 13, 1884, 21, including Edison, were connected with the telegraph business.

Perhaps in contrast to Green, I have to disclaim any personal connection with engineering except that which rubs off on me by daily contact with engineers. My formal training was in accountancy. But the distinction need not be labored. Under the American system of free enterprise, business and engineering team up ideally in harness. We all bend our backs to the same load. We share a common responsibility to the public. Ours is a joint trusteeship. Both as to electric power and electrical communication, modern utilities and manufacturing have had to learn to adjust to the strains produced by a rampant technology, just as engineering has had to learn to function within the constraints of the marketplace. So, there is much interdependence between us, and, I will venture, mutual respect.

COLD WAR SPUR

THAT MAKES ME BOLD to mention certain matters which should interest engineers because they interest businessmen. For example, there is the impact of war. Including preparation for World War II and its aftermath, there has been a preoccupation with military matters for a period of 20 years. The future is going to depend greatly upon how long this posture of defense is to be continued. The Government is engineering's biggest customer and, more fundamentally still, a prime mover of its developments, an arbiter of its laboratory projects, and a competitor for its scientific manpower.

Then there are the Soviets, and an awareness here in the United States of their recent rate of progress. The range and complexity of American engineering have received fresh and sudden impetus from the linking of a necessity to achieve with a laudable objective to survive. The latest phase of the cold war resides more in the realm of technology than in that of liberal arts. This has shifted prime responsibility for results squarely upon science, engineering, and the business organizations which foster them. We enter the future shouldering this mutual burden.

INTEGRATION OF POWER AND INTELLIGENCE

BUT, IF OUR OUTSTANDING PROBLEMS are great, so are our resources. Significance is to be attached to a gradual, fairly recent blurring of the stark lines which heretofore segregated electrical development into compartments, such as one for the transport of power and a separate one for the communication of intelligence. Your Institute is broad enough to include both. It has put electronics to work as advantageously in mercury-arc rectifiers as in radio receivers. It can foster a give and take

Essentially full text of an address presented at the AIEE Founders' Day Luncheon, Hotel Astor, New York, N. Y., May 13, 1959.

W. P. Marshall is president, The Western Union Telegraph Company, New York, N. Y.

across this old artificial boundary, to the profit of both sides. The world has already entered a domain where electrical mind is controlling electrical muscle in the most delicate demonstrations of automation.

An illustration of this was one of the wartime contracts my company carried out for the armed forces. We developed in our laboratories a simulated night-fighter training aid, consisting of a realistic airplane cockpit, complete with sound-effects and vibration, under a dome representing the sky. The trainee, with control of his plane's flight and gunfire, pitted himself against an enemy plane, first located by radar, then made apparent by a swiftly enlarging image on the dome, coming right at him, projected by a device not unlike those used in planetariums. Backstage, an analog computer arrangement figured out relative positions of the two opposing fighters in three-dimensional space, and gave the correct answers as to whether the fighter's gunfire reached target or by how much it missed. Nowadays that simulator has become the real thing. We have SAGE and Nike—massive, powered gun-director and fighter systems actuated by telegraph pulses picked up by a radar interception of the enemy. Here indeed is electric power and intelligence teamed in double harness.

TECHNICAL BARRIERS BREAKING DOWN

ENGINEERS RECOGNIZE a thread of unity running throughout electrical communication, and are witnesses (where they are not, indeed, the authors) of the breaking down of technical barriers which were erected during the communication industry's infancy. Frequency modulation, for example, was originally employed to eliminate static from received radio signals. However, in the telegraph business the value of the arrangement for use in minimizing crosstalk between adjacent wires on pole lines and in multi-pair cable was quickly recognized; and, in 1939, frequency modulation became the telegraph company's standard for carrier transmission. Facsimile, too, shows up in various communication applications, but nowhere to better effect than in handling telegrams and in facsimile wire systems leased to users.

Electronic amplifiers were applied at the ends of submarine telegraph cables as early as 1924, and Americans were first to submerge intermediate, shore-powered amplifiers in ocean depths (1950) to speed up transatlantic cables. Telegraphy was first in the United States to establish intercity microwave radio transmission (1945), and has joined with telephony in giving wide employment to this economic mode of transmission. Without electronics the newer systems being utilized to transmit data at high speeds and with requisite accuracy could not be made available. The telegraph company, like others, is seeking to take advantage of modern devices like masers and parametric amplifiers, which our engineers tell me are typical of today's tools that will become basic to tomorrow's operating systems.

BROADENING OF INTERESTS A RESULT

IN THIS ELECTRONIC AND NUCLEONIC AGE, technical developments by engineers in any industry may well prove useful to many others. Numerous interrelationships between companies have been brought about for this reason. For example, the telegraph company has invested in seven companies active in the electronics and allied fields. These activities include such diverse items as computer design, gamma ray projectors, magnetrons, Varactor diodes, a nuclear fall-out monitor, and parts used in ICBM's and space satellites.

Only a few years ago, the telegraph business was almost exclusively concerned with transmitting intelligence as language. Today, nonlanguage telegraph signals are assuming importance. By means of binary or ordinary ON–OFF signals, accumulated, stored, or sampled information controls machines, sometimes at great distances. Hence, we have automation applied in factory production, and automation applied to business operations.

For years we have been storing telegraphed words briefly in strips of paper tape by means of punched holes, without thinking of such tapes as memories. But such they are, and their kinship to punched cards used in business machines suggested that the information stored in cards could be converted for storage in tapes, and vice-versa. From this, it was only a step before we were really telegraphing our punches. Now every night, the time-cards punched by telegraph employees in various cities in the United States are wired into key centers where the time-clock notations are translated, in a couple of jumps, into paychecks. At the same time, and with the same data, the significent figures of hours, units of work, and pay are extended onto reports that disclose production and cost levels for management control purposes. The same methods of data processing are used, on many private wire systems we lease to industry, to give management of highly decentralized organizations the information required for daily centralized control.

This all started with a dawning realization, about 20 years ago, that arithmetic could be performed on 2 fingers as easily as on 10; hence, that the open and closed positions of an ordinary telegraph relay, or switch, or vacuum tube, could be used for full control of calculating machines.

SPREADING USE OF COMPUTER TECHNIQUES

WE TELEGRAPH PEOPLE were glad to contribute teleprinters and digital techniques to the pioneering models of computers, built in 1945. It was not long before the computer folks on a local basis were doing flip-flops (as they like to call it) away up in the kilocycles per second, and read-outs at the rate of a whole line of typewritten copy at a time. It is natural that communicators have a deep interest in computer techniques. For example, Western Union's most recent electronic switching complex makes great use of stored program com-

puter techniques to attain flexibility, versatility, and higher efficiency of operation.

One can hardly overestimate the potentialities of the sensing, memory, discrimination, logic, and other thought processes being built into modern computers. Already great progress is being made in this field. Our engineers are working now on a private wire system to be used exclusively for transmitting data and capable of handling about 7 million punched cards a day.

We can expect private wire systems of the future to be equipped with machines and systems that will respond to spoken direction. Such systems will be engineered so that they will be capable of transmitting digitized voice, facsimile, and other arbitrary data. This means that the system will have equipment so designed that a person can talk and the device will recognize words, interpret them into digits suitable for wire transmission and then, at destination, translate the digits into written language, or record them for processing by business machines and computers.

The entry into business of machines which can effectively complement human clerical endeavor will have a radical effect on the tempo, volume, and efficiency of business. The more common these sophisticated machines become, the greater the number of complex problems that will be presented to them to solve. Probability problems, problems involving the social and economic sciences—why we behave like human beings—will yield to these machines. Problems involving trial and error, and the comparative worth of alternative methods—operational research—will come within the range of solution, where up to now their complexity has defied solutions.

It is only a step from what we have now into space—and nowadays, it seems, the sky's the limit. In the future, we may expect the military to have a whole network of satellites for the purpose of providing communications between any points on the surface of the earth, including the polar regions. These satellites will really be giant switchboards in the sky, capable of transmitting thousands of messages to U. S. Armed Forces around the world—instantly.

One, however, does hesitate to take both feet off the ground. After all, business and engineering have obligations to present customers which are not to be lost sight of. Much of what we continue to do must be for bread and butter, not pie-in-the-sky.

But no one in a business founded on engineering is neglecting participation nowadays in the opportunities being opened up in the atom and the cosmos. For the extent to which the past will prove to be prologue to the future of electrical engineering is to be judged by the astonishing progress being recorded today, in and above the stratosphere, and within the environments of fission and fusion. Your technology holds nothing more promising than the prospect of putting the atom to work in the generation of electricity, either through, or bypassing, the steam cycle—unless, indeed, it is the co-ordination of intelligence and power through which man will enter and explore the fastness of space.

In both spheres, your members and our industrial concerns are eager participants and worthy trustees. As Edison, in his incandescent lamp, found a way to "subdivide the arc-light," so members of your Institute some day will find many ways to subdivide the energy unleashed by the atomic bomb.

And I feel equally confident that out of our radar bombarding of the moon and Venus, out of our transmission of measurement data and intelligence across vast interplanetary distances, out of the precision of our control of space vehicles and satellites, will come a stream of contributions to the peace, satisfactions, and welfare of mankind.

Winding of 97-Ton Rotor

Winding of the 97-ton rotor is nearly complete at the Westinghouse Electric Corporation for the 330-mva 45-psig 16.5-kv turbine-generator for the Consolidated Edison Company of New York. This 1,800-rpm inner-cooled generator is said to be the largest unit of this speed ever built. Scheduled to be shipped in late 1959, the unit will be installed in the Consolidated Edison Company's Indian Point nuclear plant now under construction near Buchanan, N.Y.

Steam conditions are 355 psig, 1,000 F, 1.0-inch Hg absolute. At maximum load, the turbine will pass 2.2 million pounds of steam per hour. Because of the large volumetric flow to the turbine exhaust, double-flow, 44-inch long low-pressure blades are used in this application.

Magnification of Switching Surges

A. J. SCHULTZ
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MAGNIFICATION of transient voltages in one part of an electric power system may occur in another part of that system, possibly at a different voltage level. Experiences such as these have resulted in system flashovers or equipment damage. The degree of voltage magnification does not necessarily involve circuit-breaker restriking or prestriking, although these factors may increase the severity of the disturbance.

The system upon which this study was performed is shown in Fig. 1. A capacitor bank C_1 is separated from all generation at same location in the system by an equivalent inductive impedance L_1. A lower voltage system is tapped off by means of a transformer at some location electrically near to C_1. A capacitor bank C_2 is on the lower voltage system with an equivalent inductive reactance L_2 between the two capacitor banks. L_2 includes the impedance of the transformer. If C_1 is energized by the switch S_1, a coupled transient voltage will appear at capacitor C_2. This overvoltage can appear on capacitor C_2 even though it is not being switched and may be considerably distant from the switched bank C_1.

The results of this study are given in the form of curves of which Fig. 2 is typical. $CKVA_1$ and $CKVA_2$ are the nameplate bank ratings of the two capacitor banks. $SKVA_1$ is the 3-phase short-circuit kva available at the location of capacitor bank C_1. $SKVA_2$ is the 3-phase short-circuit kva corresponding to L_2 with an infinite bus behind L_2.

From this study, it may be concluded that:

1. For the circuit conditions studied, voltages as high as five times normal line-to-neutral crest voltage can occur at a capacitor bank remote from the capacitor bank being energized. Restriking on de-energization can result in even higher voltages.

2. The magnified transient voltages tend to increase as the regulation of the primary circuit increases and as the short-circuit kva at the switched bank becomes larger with respect to that at the remote bank.

3. The results appear to be independent of the type of transformer connection or of the presence of a transformer between the two capacitor banks.

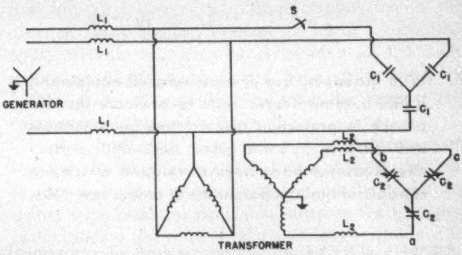
4. Grounding the switched bank but not the remote bank will reduce the magnified voltages by about 20%. Grounding the remote bank only has no effect on the magnified voltages. Grounding both banks may not appreciably effect the magnified transient voltages, depending on the transformer connection.

5. The use of a resistance about equal to one half of the capacitive reactance of the switched bank across the contacts of the circuit breaker minimizes the transient voltages at the remote and switched banks.

6. The phenomenon of voltage magnification involves a circuit having two coupled loops, each having a natural frequency of oscillation. Voltage magnification appears greatest when these two natural frequencies are about the same; magnification increases as the surge impedance of the second loop ($Z_2=\sqrt{L_2/C_2}$) increases with respect to that of the first loop ($Z_1=\sqrt{L_1/C_1}$).

7. If the switched capacitive element is a transmission line, the magnified voltages are much less.

8. Voltage magnification may be eliminated by detuning the circuit such as changing the location of C_2 or switching the higher voltage bank C_1 in two or more sections.



▲ Fig. 1. Miniature system representative of those studied. Turns ratio of miniature transformer 1 to 1.

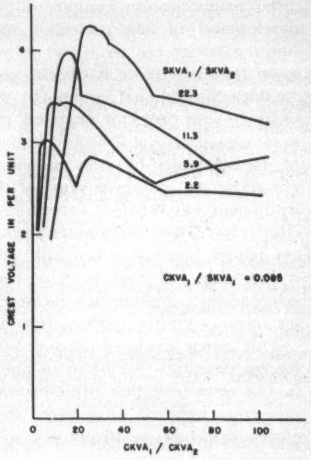


Fig. 2. Comparison of maximum magnified voltages to ground vs $CKVA_1/CKVA_2$ for the circuit of Fig. 1 with $CKVA_1/SKVA_1=0.085$ for various values of $SKVA_1/SKVA_2$. ▶

Digest of paper 58-1178, Recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Pittsburgh, Pa., Oct. 26-31, 1958. Scheduled for publication in AIEE *Power Apparatus and Systems*, Jan. 1959.

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Electrical Protection for Transistorized Equipment

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With increasing use of transistorized equipment, it has become necessary to re-evaluate the approach to protection against foreign potentials and currents. In some cases, additional protective measures have been developed which are capable of limiting potentials to only a few volts.

THE TREND to miniaturization of components and the expanding use of transistor circuitry in communication equipment has necessitated the development of new protection measures capable of limiting foreign potentials and currents to values much lower than heretofore has been necessary.

Older conventional equipment was designed to coordinate with protector discharge gaps having a minimum gap spacing of 0.0028 inch and a sparkover value of 500 peak volts. In order to insure an adequate margin above the sparkover value of the protectors, such equipment was required to withstand a minimum dielectric test of 500 volts rms. In the case of transistorized equipment, however, it is usually not feasible to attain such a withstand level, so it has been necessary to develop additional protection measures capable, in some instances, of limiting potentials to only a few volts.

This article discusses the source and nature of the foreign potentials hazardous to the dependable operation of communication equipment and the additional protection measures that have been successfully employed to protect relatively delicate equipment of recent design.

SOURCES OF FOREIGN POTENTIALS

COMMUNICATION EQUIPMENT associated with land transmission facilities, both aerial and buried, is frequently exposed to abnormal potentials produced by lightning, which in practice constitutes the major electrical hazard. Although communication lines and cables frequently occupy pole facilities jointly with power circuits, because of good construction and co-ordination practices power contacts are relatively few, and equipment damage from this source is much less likely than from lightning.

Equipment powered from aerial power distribution facilities in suburban and rural areas is vulnerable to lightning surges entering an installation over the service conductors. Furthermore, failures in rectifiers employing semiconductor diodes have been experienced at times when thunderstorms have not been reported in the general area.

For economic reasons, such equipment is frequently designed to have a relatively small inverse voltage safety factor; consequently, it has become necessary to consider the effects of switching and other operating transients from the power source. Furthermore, although not within the intended scope of this article, it nevertheless is interesting to note that semiconductor diodes employed in power rectifiers in addition to their vulnerability to foreign potentials may also be susceptible to damage from internal transients that develop when normal line voltage is applied. This situation should be anticipated by the designer and has recently received some mention in manufacturers' bulletins and published papers.[1]

The exposure of a radio installation to lightning strokes to the antenna is well recognized, and adequate consideration is generally given to the protection of an installation against damage from this source.[2] However, it is not so generally recognized that the probable incidence of strokes to an antenna may, in many cases, average less than one a year; yet the station equipment will probably be exposed each year to several lightning surges from the power lines, some of which may be of sufficient magnitude to cause tower lamp burnout, relay contact burning, and rectifier troubles.

Since the measures employed to protect equipment from foreign potentials on the communication transmission facilities are considerably different from those employed on the associated power circuits, it will facilitate the discussion to consider them separately.

Communication Lines and Cables. Lightning surges of sufficient magnitude to be significant from the protection standpoint appear in communication lines and cables as a result of the following:

1. Direct strokes to aerial and buried plant.
2. Exposure of buried plant to earth potential gradients.
3. Exposure of aerial plant to flashover from adjacent facilities and potential rise of associated grounds.
4. Induction in nonshielded facilities.

External Power Facilities. Several years ago, rectifier tube and capacitor failures were experienced in power supplies at intermediate telephone carrier and radio

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The authors wish to acknowledge the assistance of Bell Telephone Laboratories semiconductor personnel, particularly K. D. Smith and H. S. Veloric.

repeater stations normally receiving their a-c power over aerial distribution lines. Such installations are usually in rural locations and served by small lines having few other users in the immediate area. Lightning surges from the power lines were suspected of being the probable cause of the equipment damage and, although little was or has been done since to determine precisely the incidence and characteristics of such surges, the effectiveness of the applied protection measures described later in this article definitely established the power lines to be the source of the troubles referred to. It was incidentally found that after protection was applied to the power service, there was a marked reduction in other equipment troubles such as lamp burnout in tower warning lights. Rectifiers employing semiconductor diodes may be even more vulnerable to power line surges than thermionic rectifiers.

NATURE OF LIGHTNING POTENTIALS ON COMMUNICATION LINES AND CABLES

LIGHTNING POTENTIALS in communication plant are primarily longitudinal (conductor-to-earth) but metallic voltages (conductor-to-conductor) develop because of circuit unbalances as a result of insulation sparkover or dissimilar operation of some types of protection devices. When there is no circuit path to ground or such path is interrupted by a transformer, it is not difficult to provide a minimum insulation withstand level with respect to ground of 700 peak volts. In such cases, 0.0028-inch protector gaps will provide adequate protection against longitudinal voltages. However, in circuits having direct paths for the line conductors to ground through components, there may be a problem concerning the ability of these components to conduct currents produced by longitudinal voltages less than the sparkover value of the protectors. In these instances, it is frequently possible by simple design changes to bring the withstand ability of critical components up to the level where they will be adequately protected by the discharge gaps.

In the more general situation, coupling transformers are used and the circuit elements on the secondary side are exposed only to metallic voltages; however, such voltages may reach magnitudes equal to the sparkover value of the higher of the two protector gaps on the primary side of the coupling transformer (500 to 600 peak volts). When low-voltage circuit components are present which may be damaged by voltages as low as 40 to 50 peak volts, as in the case of transistors, additional protection measures are required.

A lightning surge at or near the stroke point is essentially unidirectional. Such a surge will, however, be modified both in magnitude and wave shape as it propagates through communication lines and cables; consequently, it is impossible to anticipate the nature of such surges except in a very general way. Observations on both open wire and cable plant indicate that surges range in wave shape from simple impulses to complex oscillatory transients. These transients vary greatly with the type of plant involved and the operation of associated protection devices. Surges that arrive at a terminal point on a line from a stroke some distance away or that have otherwise been attenuated so that they will not spark over protector blocks do not have frequency components as high as commonly supposed. For example, some observations of surges on an open-wire toll line indicated varying amplitude components in the order of 20 kc having durations of 1.0 to 1.5 milliseconds. Metallic transients observed in a loaded cable pair were highly damped and had fundamentals of 1,500 to 2,000 cycles, with amplitudes decaying to half value in a millisecond or less.

It was from such data that a 10x600-microsecond impulse test wave* was established as suitable for laboratory testing of protection diodes on the basis that such a wave produces equivalent duty on the test specimens. Such a test wave is relatively easy to produce in the laboratory and, through correlation with field experience secured with equipment so tested, provides a satisfactory basis for evaluation of circuits and components.

In one study of foreign metallic voltages on a pair in a metallic sheath cable, 249 surges ranging in amplitude from 40 to 550 peak volts were observed during a total of 10 thunderstorms. The magnitude distribution of these metallic surge voltages is shown in Fig. 1. The upper limit of 550 peak volts was due to the presence of 0.0028-inch protector discharge gaps.

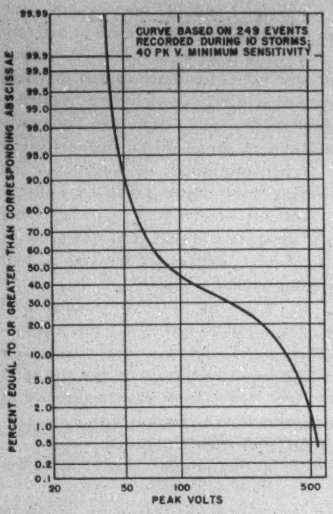
PROTECTION MEASURES

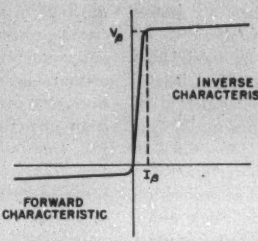
PROTECTOR DISCHARGE GAPS are the most economical devices available for the initial limitation of both longitudinal and metallic potentials in communication circuits and such protectors having nominal gap spacings of 0.0028 inch are used at subscriber and terminal equipment points without an unreasonable amount of protector maintenance. Smaller gap spacings are impractical from a maintenance standpoint, so where protection is required below about 600 peak volts, some auxiliary method must be employed. Semiconductor protector diodes have been successfully employed in this lower range. Generally, it has been possible to protect transistorized equipment using available voltage limiting diodes in the range from about 6 to 68 peak volts. Specific methods of application will be discussed later.

SEMICONDUCTOR PROTECTION DIODES

General Characteristics. Semiconductor diodes have inverse conduction characteristics that make them exceptionally fine voltage limiters. Such devices present a very high resistance when inverse voltages below a critical "avalanche breakdown" value are applied and also show a well-defined region of substantially constant voltage limitation above this critical breakdown value (Fig. 2). Although the term "breakdown" is commonly

*This is a unidirectional wave that rises to crest value in 10 microseconds and decays to half its crest value in 600 microseconds measured from $t=0$.





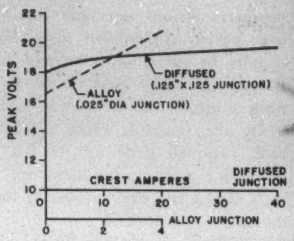


Fig. 1 (left). Distribution of metallic voltage surges which were observed on a loaded cable pair during local thunderstorms. Fig. 2 (above left). Generalized semiconductor diode characteristic curve. Fig. 3 (above right). Voltage-limiting characteristic curve for typical silicon protection diodes.

used in referring to the critical voltage range in which a junction changes rapidly from a high-resistance barrier to a good conductor, the term may be somewhat misleading, inasmuch as the phenomenon is not destructive when confined to design limits.

Silicon is preferable to germanium for voltage limiters because it provides a much sharper transition from the high- to the low-resistance region and will handle more power without a permanent change in characteristics.

Two general types of silicon diodes suitable for protection purposes are now available, the alloy junction[3] and the diffused junction.[4] They have a general similarity in operating characteristics, but the latter type can be more easily produced, having larger effective junction areas. Diffused junction units are presently available having effective junction dimensions of about 0.125 by 0.125 inch as compared to the alloy types having a maximum effective junction diameter of only about 0.025 inch. For protection applications where the higher capacitance of the larger junction area can be tolerated, the diffused junction diodes offer distinct advantages because of their greater current-carrying ability and their lower effective resistance, resulting in a smaller increase in voltage above the breakdown value with increasing surge current, as may be noted in Fig. 3. In the application of protection diodes to circuits in which surges of both polarities may appear, it is necessary to use two units in series and oppositely poled.

The forward-conductivity characteristics of semiconductor junctions may also have application for protection purposes in situations where the normal circuit voltage levels are very low. A significant change in forward junction resistance occurs in the case of silicon at about 0.5 volt. Although the transition is less sharp than in the inverse direction, it may provide sufficiently effective voltage limitation, despite the relative "softness" of the voltage characteristic, because of the very low magnitude at which it starts to limit.

To utilize the forward characteristic in protection applications, it is necessary to employ two oppositely poled junctions in parallel. Such double-unit devices, encapsulated in one envelope similar in appearance to a resistor, have been developed; and because of the nature of the junction material employed, there is every indication that they will be very low in cost when in production. In spite of their small physical size, such devices have the ability to conduct surprisingly large values of surge current and have interesting circuit application possibilities which will be discussed later.

Inverse Voltage Breakdown Ratings. Protection diodes are rated on the basis of their nominal inverse breakdown value. This rating refers to the small region at the knee of the inverse voltage–current characteristic curve and is established on the basis of a specific current value, commonly 0.5 milliampere. At present, practical protection diodes can be produced having breakdown ratings ranging from about 6 to 150 volts d-c.

The response time of a semiconductor diode is extremely fast—in the order of millimicroseconds. Therefore, it may be assumed that for protection purposes, the inverse voltage breakdown point for a lightning surge will be the same as the d-c rated value.

Inverse Surge Current-Carrying Ability. Semiconductor diodes have a higher resistance in the inverse conducting direction than in the forward direction. Since in most protection applications the diodes are required to conduct current in either direction, their inverse current carrying ability is the restricting factor in such applications.

Data on inverse current (also referred to as reverse current) given in manufacturers' data sheets generally refer to steady-state direct current and, consequently, have little relationship to the ability of a diode to safely conduct intermittent surges or short duration transients. Consequently, valid ratings must be determined by specific tests employing a wave shape comparable to that which the device is likely to experience in the

field. For practical reasons, a unipolarity wave is generally employed in such tests and is selected on the basis of equivalent duty. Field experience has indicated that for communication applications, ratings based on a 10x600-microsecond wave are reasonably conservative and satisfactory for engineering purposes. The Western Electric Company plans to include in published data sheets information on the inverse surge current capabilities of its protection varistors (generic term used by Western Electric in coding its nonlinear devices).

Test experience shows that diodes subjected to intermittent surges within their current rating do not appear to suffer any progressive degradation. If failure occurs on moderate overloads, it will be short-circuiting, which is preferable, from a protection standpoint, to an open condition. Furthermore, in testing diodes in connection with establishing their duty ratings, tendency to fail will be revealed after only a few applications of a surge of critical value.

The inverse current carrying ability of a junction is directly proportional to its area and inversely proportional to its breakdown voltage; consequently, the higher voltage junctions limited in area to those presently available (0.125 by 0.125 inch) have low current ratings which restrict their application. However, diodes having lower voltage ratings may be connected in series and thereby meet higher current-carrying requirements.

Table I gives the surge current ratings of several miscellaneous silicon alloy and silicon diffused junction protection diodes.

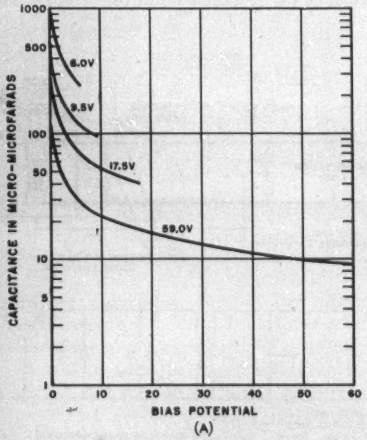
Table I. Inverse Surge Current Carrying Ability of Silicon Protection Diodes*

Average Breakdown Voltage	Wave Shape of Applied Surge	Withstand Currents, crest amperes		
		Minimum	Median	Maximum
Silicon Alloy Diodes (0.025 inch)†				
6.0	1½ x 40	80.0	90.0	100.0
6.0	10 x 600	10.0	12.0	24.0
9.5	1½ x 40	11.0	17.0	55.0
9.5	10 x 600	5.0	9.0	11.0
17.5	1½ x 40	16.0	28.0	32.0
17.5	10 x 600	4.0	7.0	8.0
59.0	1½ x 40	3.0	4.0	5.0
59.0	10 x 600	1.0	1.0	1.25
Silicon Diffused Diodes (0.45 inch)‡				
8.0	10 x 600	10.0	—	—
38.0	1½ x 40	20.0	22.0	24.0
38.0	10 x 600	3.5	3.5	4.0
72.0	10 x 600	1.5	1.6	2.0
Silicon Diffused Diodes (0.125 inch)‡				
17.0	1½ x 40	170.0	—	—
17.0	10 x 600	35.0	40.0	50.0
66.0	1½ x 40	45.0	50.0	65.0
66.0	10 x 600	8.0	9.0	10.0

* The specimens tested were chiefly experimental or preproduction units, so do not necessarily indicate the probable performance of production units.
† Approximate diameter of effective circular junction of alloy types.
‡ Dimension of square wafer used in diffused types; approximately entire wafer area is effective junction.

Diode Capacitance. The capacitance of protection diodes varies with impressed voltage. Capacitance variations with changes in signal level rarely present a problem in lower-frequency applications or when connected at low-impedance points in a circuit. In carrier applications, however, the possible effects of capacitance variation should be considered. The theory of diode capacitance is quite complex, but an understanding of the general relationships is sufficient for practical purposes. In general, capacitance is directly proportional to junction area and, in the inverse direction, is inversely related to diode breakdown values. Also the capacitance of a given unit will decrease with the application of inverse bias voltage. These relationships are shown in Fig. 4. In the forward conducting direction, the capacitance of a junction will increase with the application of forward bias voltage.

Physical Size. Several types of diodes produced for surge protection purposes are shown in Fig. 5. It may be noted that these units do not employ heat sinks as in the case of diodes intended for rectifying applications because the sink would not increase their intermittent surge current carrying ability.



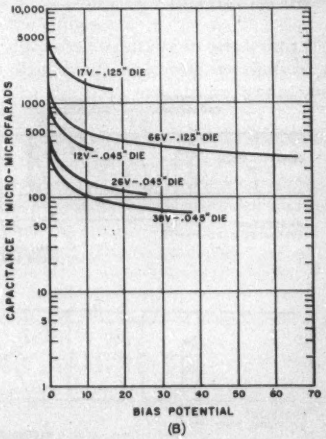


Fig. 4. Capacitance as a function of bias potential: (A) For silicon alloy diodes, with assumed junction area of 0.0024 square centimeter; (B) For diffused silicon junction diodes.

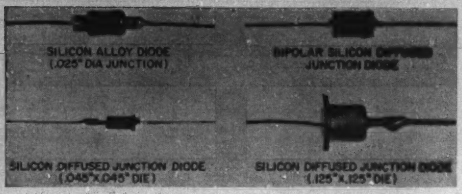


Fig. 5. Semiconductor voltage limiters. Scale approximately full size.

APPLYING COMMUNICATION PROTECTION DEVICES

SEMICONDUCTOR DIODES can be arranged to provide both longitudinal and metallic protection. They are chiefly employed, however, for metallic protection, since most transmission apparatus is coupled to the line by transformers, which effectively interrupt the longitudinal path. Generally, the dielectric strength of the transformers with respect to ground will exceed 600 peak volts and discharge gaps will provide adequate voltage limitation.

Two simple arrangements utilizing the inverse breakdown characteristics of semiconductor diodes are shown in Figs. 6 and 7. The first arrangement (Fig. 6) could be used to limit metallic voltages appearing at the line terminals of carrier equipment. The limiting resistance r_l is selected to limit surge-current magnitudes to values within the short-duration current capabilities of the diodes. The minimum value of limiting resistance that may be used depends upon diode design and the duration of the current surge. In some applications, resistance values as low as 10 to 20 ohms may be adequate. In carrier applications, a series blocking capacitor may be used to protect the equipment against 60-cycle power currents if the exposure conditions warrant.

Fig. 7 shows a protection arrangement for voice-frequency equipment. The only difference in this case is the substitution of a fuse for the blocking capacitor to protect the diodes against long-duration foreign currents.

In practice, it will be found that considerable flexibility in diode application is possible. Because some components, such as line coils, will generally withstand surge voltages up to the operating value of the protector gaps, the diodes need not necessarily be placed at the input to the equipment but may frequently be connected in the circuit closer to the vulnerable components. By this means, it may be possible to utilize some existing circuit impedance to limit the surge current through the diodes to a value compatible with their rating. Furthermore, it may also be possible, as shown in Fig. 8, to select a diode location having a d-c bias voltage and then only a single diode will be required.

An application utilizing only the forward conducting characteristic of silicon diodes for protection purposes is shown in Fig. 9. The maximum normal voice-frequency voltage is assumed to be no greater than about 0.1 volt, in which case a bipolar unit can be employed without adversely affecting system operation. Because of the anticipated low cost of such protector units, it might be economically feasible to employ several such units in series to allow their application to a higher-voltage circuit if the situation requires.

PROTECTION FROM POWER DISTRIBUTION SURGES

THE FIRST STEP in reducing the magnitude of power line surges entering an installation is by the use of arresters on the secondary service conductors. In this application, the preferred location for these arresters is at the service weatherhead for reasons to be subsequently discussed.

Standard secondary arresters are available having sparkover values of the order of 1,600 peak volts and capable of interrupting the subsequent 60-cycle short-circuit current at secondary voltages up to 175 volts rms to ground. There is a significant protection advantage in securing station service on either a 120-240-volt 3-wire or a 120-208-volt 4-wire basis. Such systems provide a grounded neutral connection for the secondary arresters whereby the potential across the arresters will

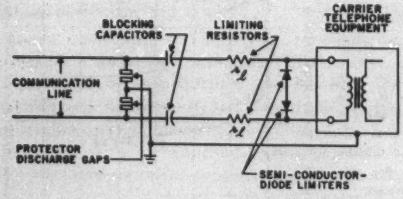
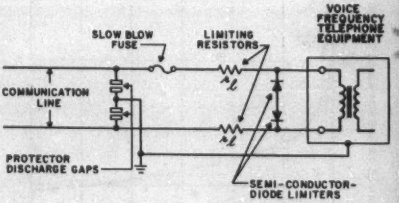


Fig. 6 (left). Protection of low-voltage carrier equipment. Fig. 7 (right). Protection of low-voltage voice-frequency equipment.



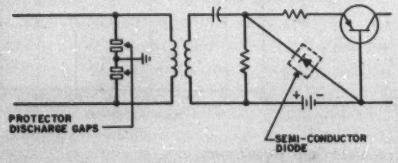
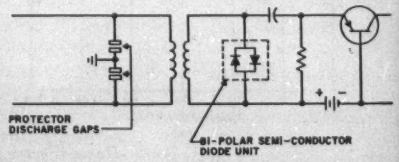


Fig. 8 (left). Application of single diode for protecting a transistor. Fig. 9 (right). Application of bipolar diode unit for protection of transistor circuitry.



not exceed their 175-volt rating. The next higher standard arrester is rated 650 volts to ground and requires potentials in the order of 2,800 peak volts to initiate sparkover.

Experience has shown that a 175-volt secondary arrester will provide dependable protection for equipment normally considered in the power class such as motors, heaters, lamps, etc. However, such arresters do not fulfill the protection requirements for certain types of communication equipment as previously discussed. Where a high degree of operating reliability is required, it has been found necessary to employ an additional stage of protection in the form of a lower-voltage arrester frequently applied to branch circuits serving critical equipment.

This low-voltage arrester is generically the same as any valve-type arrester consisting of a silicon carbide varistor (nonlinear element) in series with a standard carbon protector gap. The varistor element has a minimum resistance at 120 volts rms of about 15 ohms to insure interruption of the 60-cycle short-circuit current after surge discharge. Gaps having nominal spacings of 0.0028 and 0.006 inch (500 and 850 peak volts sparkover, respectively) have been used, but it is desirable to design equipment capable of co-ordinating with the 0.006-inch gap, inasmuch as it will withstand about four times greater duty than the smaller gaps without permanently grounding.

When power voltage regulating devices are employed ahead of critical equipment, they frequently introduce sufficient surge attenuation so that the lower-voltage arrester is not required.

To insure successful operation of the 2-arrester combination, it is necessary to have regulating impedance between the two units. This insures operation of the higher-voltage secondary arrester, which limits discharge current through the lower-voltage arrester,

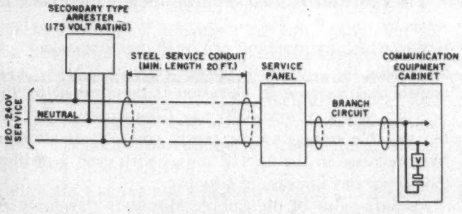


Fig. 10. Low-voltage arrester applied to a branch circuit.

thereby preventing the arrester discharge voltage from exceeding the initial sparkover value of the gaps and insures satisfactory gap life. Although a discrete impedance could be inserted between the two arresters for this purpose, it is the practice to utilize the impedance offered by wiring run in steel enclosures. In Bell System installations, steel service conduit is employed and in order to secure its maximum benefit, the secondary arresters are located at the weatherhead. Laboratory tests and field experience show that a 20-foot conduit run will give satisfactory results. Since 20 feet is about the minimum length normally used in our installations, the low-voltage arresters may be located in the area of the service cabinets if desired. However, these low-voltage arresters are frequently placed in the equipment cabinets to secure the benefit of longer wire runs.

Two principal methods of application are used. In installations where there are spare equipments with provision for automatic switching of units or where the rectifiers are of the trickle type and the equipment, in turn, operates from a battery, the arresters are placed directly on branch circuits, as shown in Fig. 10. In such cases, the branch circuit overcurrent protection device may be allowed to operate if an arrester should become

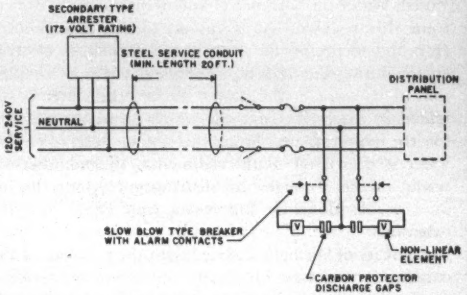


Fig. 11. Low-voltage arrester arrangement located at a common feed point.

permanently grounded. In situations where service continuity is not assured by the means mentioned, the arrester circuits are provided with their own alarmed disconnect devices as shown in Fig. 11 to avoid de-energization of the equipment.

The use of a disconnecting device in series with the arrester has the disadvantage of leaving the equipment unprotected during the time required to service the arrester. However, the situation involves a compromise and it has been assumed that the exposure of the equipment during this period constitutes less risk of service interruption than from the operation of a circuit fuse or breaker caused by a permanently grounded arrester bridged directly on the circuit.

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Operating a Hydro Station and Water Supply System

ANTONIO FERREIRA

COMBINING the output of a watershed for the generation of electricity with the supply of water for domestic consumption produces interesting problems, which the Western Massachusetts Electric Company (WMEC) and the City of Springfield, Mass., have successfully solved in the unique arrangement which integrates the two water uses. The electric utility company and the municipality embarked upon this joint venture with the signing of an agreement on June 21, 1928. Runoff from a 45.8-square-mile drainage area is impounded in the Cobble Mountain Reservoir system where an aggregate of 3,000 million cubic feet can be stored. Water for both power and domestic use is drawn from this reservoir via a tunnel to the powerhouse. Here the energy in the water is transformed to electric energy during the peak hours of the day. Upon completion of its work at the power station, the water is retained in the intake reservoir which forms the tailrace for the power plant. From this intake reservoir, the water is drawn off to the sedimentation and filtering works, hence through the distribution system to its final use as domestic supply for Springfield and its neighbors.

The City of Springfield, faced with the problem of increasing its water supply system compared the periodical development of small reservoir systems with the construction of a large dam and reservoir system. The one large dam system would ultimately furnish to the City an average daily use of 55 million gallons, such amount not required until sometime after 1970. This extensive development meant an expenditure beyond the capability of financing by the City without some form of reimbursed aid. The significant difference in elevation between the proposed Cobble Mountain Reservoir on the Westfield Little River and the existing water supply intake reservoir, some two miles downstream strongly suggested the possibility of converting this potential energy to electric energy.

Investigation by the electric utility indicated that the site could not be economically justified as a power development by itself but did show that an integration of the two uses would be beneficial to both WMEC and the City. Evolving from these investigations was an extremely advantageous and unique arrangement which enables the City to derive revenue from the use of water before it enters the distribution systems.

The contract between WMEC and the City of Springfield provided that the City was to construct the dam and storage reservoir, the outlet pressure tunnel, and the overflow spillway. The maintenance of these would remain the responsibility of the City. The power company was to build the hydroelectric plant and transmission facilities necessary to generate and deliver the electric energy. Upon completion, the power plant was turned over to the City and the utility was reimbursed a sum of $1,100,000 and, in turn, the City leased to WMEC the right to occupy, use, and operate the hydroelectric development, gates and tunnel for a period of 30 years from the day when Cobble Mountain Reservoir had filled with water to an elevation 30 feet below full reservoir level. The maintenance of all plant under lease was to be the responsibility of WMEC and all leased plant was to be surrendered to the City at the termination of the lease in good order and working condition. Rental was set at $270,000 per annum paid in monthly installments with further provisions for slight adjustments.

Construction began in 1929 and the specified water level was reached on November 12, 1932, bringing into effect the power lease.

Original studies indicated a capacity of 23,000 kw when operated at a minimum effective head of 330 feet, with the maximum effective head of 420 feet resulting in a capacity of 33,000 kw. The plant is operated on the WMEC load curve as a system relay plant furnishing firm capacity during the low hydro periods of the Connecticut River when the output from WMEC's run-of-river plants is reduced. The average annual runoff from the watershed was computed to result in about 20 million kwhr of energy. Actual average annual output has been approximately 23 million kwhr.

Present water supply requirements from the reservoir average about 33 million gallons per day. The City draws water steadily for its needs from the intake reservoir. The replenishing of this water is accomplished by releasing the water from Cobble Mountain Reservoir during the peak load hours of the day.

The City assures itself of a continually increasing reserve by providing for an increase in minimum elevation to which the reservoir can be drawn for power, thus decreasing the amount of storage allowed WMEC. This contractual increase in elevation is determined by the previous year's average daily use. Compensation for loss of available storage to the power company is afforded by a decrease in the annual rental with each 5 million gallon per day increase in City use.

Primary value of the Cobble Mountain development to the City of Springfield has been in arranging for the derivation of revenue from the use of the water before it enters the domestic distribution system. WMEC benefits through the economical addition of firm capacity to its system.

Digest of paper 58-866, "Twenty-Seven Years of Operating a Hydro Station in Connection with a Water Supply System," recommended by the AIEE System Engineering Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting and Air Transportation Conference, Buffalo, N. Y., June 22-27, 1958. Published in AIEE *Power Apparatus and Systems*, Dec. 1958, pp. 960-69.

Antonio Ferreira is with the Western Massachusetts Electric Company, Springfield, Mass.

Lamme Medalists for 1958

". . . In recognition of their contribution to the art and science of design and application of rotating electric machines."

History of the Medal

M. A. PRINCI
MEMBER AIEE

THE LAMME MEDAL, which is to be awarded to two outstanding members of the AIEE today was established by Benjamin Garver Lamme in his will. The purpose of the award is to give deserved recognition to Institute members who have shown "meritorious achievement in the development of electrical apparatus or machinery." In considering candidates for the award, the members of the Lamme Medal Committee have exercised the greatest care to insure compliance with the founder's intent in establishing it.

The Deed of Gift very clearly defines the type of "meritorious achievement." Any work which meets this requirement is admissible whether it be (a) in development of the theory involved; (b) in development of the characteristics of the material employed; (c) in development of the over-all design; or (d) in development in other ways which results in substantial improvement in electrical apparatus or machinery. The words "electrical apparatus or machinery" shall be taken to indicate "discrete and self-contained devices," which may or may not include mechanical moving parts without limitation as to the field of application.

Benjamin Lamme was a brilliant design and development engineer—a modern pioneer in his field. His accomplishments are well known and recorded and were recognized by the AIEE when he was awarded the Edison Medal in 1919. Uppermost in his thinking was the advancement of the engineering profession through education and through incentives toward better living for mankind. His work with Westinghouse began early in 1889, and in instructing young engineers in his company he inspired in them the desire to "look to the future." He could foresee how the equipment he developed would be used in a complete system from the power source to its utilization. His philosophy can best be stated by the quotation inscribed on the medal which bears his name. It reads, "The Engineer views hopefully the hitherto unattainable." This was Mr. Lamme's ideal and his will provided a means of giving suitable recognition to those who attained the "hitherto unattainable."

The Lamme Medal Committee members feel that their selections for 1958 for the Lamme Gold Medal, together with a bronze replica, to Philip L. Alger and Sterling Beckwith will confer further distinction upon the list of distinguished Lamme medalists.

Presentation and acceptance addresses made at the ceremony awarding the Lamme Medal during the AIEE Summer and Pacific General Meeting and Air Transportation Conference, Seattle, Wash., June 21-26, 1959.

M. A. Princi is with General Electric Co., Lynn, Mass.

Career of Sterling Beckwith

L. T. ROSENBERG
FELLOW AIEE

ONE OF THE TWO distinguished Institute Members being honored here today is my esteemed friend and associate Dr. Sterling Beckwith. It was my good fortune to have worked with him in the design of rotating a-c machinery at the Allis-Chalmers Manufacturing Company for nearly 20 years. It is indeed a privilege to review his career for you, and to explain the significance of some of his more important contributions to the art of electrical machine design.

Sterling Beckwith was born October 29, 1905, in Carthage, Mo. Graduating from Stanford with a B.S.

L. T. Rosenberg is with Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

degree in 1927, he was enrolled in the Graduate Training Course at the Westinghouse Electric Corporation, where he later became a design engineer on large generators.

During this period, his keen analytical mind and his capacity for intense concentration, which were destined

Sterling Beckwith

later to carry him on to great achievements, were already apparent. These traits, together with a persistent eagerness for knowledge, spurred him on to obtain his M.S. degree in electrical engineering from the University of Pittsburgh. His later contributions in the field of ventilation probably had their beginnings in his Master's thesis, which was titled "Axial Distribution of Air Flow in Alternators."

In order to complete his graduate work toward the Ph.D. degree, Sterling accepted a part-time teaching assistantship at the California Institute of Technology in 1931. Two years later, he was awarded the Ph.D. degree, *cum laude*. During the next 2 years he served as assistant engineer for the Metropolitan Water District of Southern California evaluating the stability of their large pumping system.

My personal acquaintance with Sterling began in 1935, when he joined the Allis-Chalmers a-c design staff. It was here that his potential talent in the field of rotating machine design was recognized and stimulated, under the guidance of Dr. S. H. Mortensen, then engineer-in-charge.

Dr. Beckwith's earliest assignments related to the further development of turbine-generator ventilation, first in air-cooled, then in hydrogen-cooled machines. He supervised experimental research on hydrogen seals and was instrumental in the development of the thrust-type hydrogen seal that greatly simplified the hydrogen auxiliaries for turbine-generators. He helped develop spiral ventilation for stators, which improved the uniformity of their temperatures by reversal of gas flow through the teeth in successive ducts.

In 1942, he was made engineer-in-charge of a-c design. In this capacity, his inventive genius coupled with his unusual engineering foresight gave birth to a series of outstanding achievements.

He developed and patented the "jet-cooled" terminal bushing that eliminated the bushing size as a factor in generator voltage considerations. By the internal cooling of the bushing stud with a jet of cool hydrogen, Beckwith made very effective use of the elevated hydrogen pressure, thus permitting currents up to 17,000 amperes in a bushing normally rated 4,500.

Dr. Beckwith designed and built the first 3,600-rpm nonsalient pole generator in the country to be used exclusively for fuse and circuit breaker testing. The machine was designed to withstand six full-voltage short circuits per hour in normal operation with asymmetrical currents up to 66 times full load. Well over 11 years of this gruelling service have failed to produce any ill effects in this generator.

Impressed by statistics indicating the exciter to be the cause of a major share of outages, Sterling began work on a commutatorless excitation system, making use of an induction generator, selenium rectifiers, and magnetic amplifiers. This project served as a background for the a-c excitation system now offered for 3,600 rpm generators up to 134 mva.

In the course of his investigation of the temperature limitations in turbine-generators, Sterling Beckwith decided to tackle the problems associated with conductor-cooling. Like early investigators before him, Beckwith saw that the conventionally cooled generator capability was greatly handicapped because the heat generated within the copper conductors had to flow through the electrical insulation to reach the cooling medium. Unlike his predecessors, however, he "viewed hopefully the hitherto unattainable," and he possessed the courage and tenacity to pursue and eliminate one by one the innumerable obstacles that had barred the way to this great forward step. In 1951, he succeeded in placing in commercial operation a 60,000-kw generator with a conductor-cooled rotor winding, that demonstrated for the first time, the tremendous increase in capability possible with this new method of cooling. This development, which has been fully described in the AIEE *Transactions*, he called "Supercharged Cooling."

Unwilling to rely on calculations alone, Sterling built full-size model coils and circulated current in them to study temperature distribution and heat transfer. He experimented with many shapes of rotor ducts and measured friction factors to afford a reliable basis for the design of a large unit.

Beckwith's tests bore out the calculations which indicated that ordinary ventilating fans were inadequate if a sufficient supply of hydrogen was to be forced through the length of the conductors in ducts within the insulation wall. He found that for a successful commercial design, the gas flow must exceed the threshold value for which the gas rise through the long gas passages equals the maximum temperature rise permissible.

In his first machine, Sterling provided a powerful two-stage centrifugal blower on the shaft capable of 5 times the highest previously used fan pressure for turbine–generators. To overcome the hazards of rotor copper distortion under thermal expansion forces, he made each turn the full width of the slot thus insuring continuous support on both sides. Adequate contact area between copper and gas was also provided to minimize temperature drop at this surface.

These were but a few of the many difficulties Sterling encountered. The effectiveness of his solutions to these problems is most convincingly demonstrated by nearly 8 years of service on that first unit, with not a single case of trouble reported in any way related to the new cooling method.

The increase in generator capacity achieved with the introduction of hydrogen cooling is generally considered to be 20 to 25%. A further similar increase was realized when gas pressure was raised to 30 psig. In contrast to these modest gains, the first generator employing the features of Beckwith's supercharged rotor design achieved an increase in capability per pound of rotor weight at ½ psig hydrogen pressure of 65% over that of the previous conventionally cooled design. Since that first generator was placed in service, the application of conductor-cooling to both the stator and the rotor, at hydrogen pressures up to 60 psig, have greatly multiplied this factor.

It is safe to say that without conductor-cooling, toward which Sterling Beckwith's contributions were so vital, many of the large turbine–generators being built today would not be possible. The compact conductor-cooled design not only saves power plant space, but also greatly alleviates thermal and mechanical problems.

In his first conductor-cooled stators, Beckwith introduced a number of important new design features. Among these may be listed: axial ducts for cooling the stator core, spring disk core-clamping plates, individually adjustable pressure equalizing fingers, magnetic flux shields, and internal jet cooling of generator leads and radiator type bushing caps.

In 1952, Dr. Beckwith became a consulting engineer with offices located in Lake Forest, Ill. He has been active on various projects such as generator cooling, transportation of liquefied natural gas at very low temperature, fixation of nitrogen, improved refrigeration, etc. His project on transportation of liquid methane to England at −258 C was placed in preliminary commercial operation early this year.

Among the honors bestowed upon Sterling Beckwith are: election to Eta Kappa Nu, Tau Beta Pi, Sigma Xi, and of course he is a Fellow of the Institute.

Dr. Beckwith has published a great many technical papers covering his developments and research projects. He is the holder of over 40 patents. His AIEE paper on "Supercharged Cooling of Generators" in 1952 was awarded 2nd place in the Great Lakes District Prize Paper Competition.

Besides his many contributions to the literature on rotating machines, Sterling gave generously of his time to Institute Committee affairs. He served repeatedly on AIEE Committees or subcommittees covering Electrical Machinery, Rotating Machinery, Synchronous Machinery, Test Code, Coordinating Rotating Machinery, Standards, Student Branches, Education, and Power Generation. He has also served on a number of ASA committees.

Perhaps of even greater significance has been the influence of Sterling's inspiring personality on those who came in contact with him. Through his capable guidance and shining example, a number of his design engineers have undertaken graduate training and several have earned their Masters degrees. Two others were granted fellowships that culminated in Ph.D. degrees.

Although his insatiable zeal for achievement kept Sterling constantly occupied, he was always courteous and considerate in his dealings with others. His quiet patient manner, his wholesome attitude toward those about him and his versatile intellect have won him many sincere friends.

I know all of his friends, and particularly those who have enjoyed working with him as I have, would want to join with me in extending hearty congratulations to Dr. Sterling Beckwith on this happy occasion of the award of the Lamme Medal to him.

The Limitless Future

STERLING BECKWITH
FELLOW AIEE

IT IS INDEED A PRIVILEGE to be honored by the Lamme Medal Award and to share it with my very worthy friend, Philip Alger.

In accepting it, I would like to turn your attention briefly in two different directions. The first of these is toward all of the others whose work contributes to the progess for which only a few receive awards.

Some of these contributors are apparent, such as developers of new materials, or of new methods of instrumentation. Others, somewhat less apparent, are the teachers and professors who keep abreast of and properly co-ordinate new progress in order to better teach our young men. Contributions are also made by those whose enlightened management makes it possible

Sterling Beckwith is a consulting engineer, Lake Forest, Ill.

to spend more time on new ways of doing things, or makes it possible to take the infrequent but important calculated risks which sometimes hurry progress along.

Still others who only find the answer "why" to a minor practical question may be almost completely overlooked. An old, old, but interesting example, perhaps not too well remembered, was the keenness of observation of the man who first identified "termites" in electrical insulation. As I recall it, a substation housing several large high-voltage synchronous condensers had operated successfully for a number of years and then encountered periods of multiple failures which were coincidental with cleaning the outside of the substation building. It seems that in the cleaning process wire brushes were used and small portions of wires were broken off in the process and dropped on the ground. From there, possibly by shoe sole and cleaning rag routes, they reached the magnetic field of the machine and a few lodged on the stator coils. In this position, their magnetically caused gyrations dug the typical craters and holes in the coil insulation which have led to magnetic particles in these locations being called termites. Now the fact that the termite itself worked out of sight and was completely consumed and destroyed by any failure meant that someone with keen powers of observation had to find not only another crater, but one which contained an actual metal particle termite. Needless to say someone did find it and engineering time was freed for more creative efforts.

Thus do many who only answer a minor question of "why" help make possible the continued progress which we have come to take for granted and for which a few of us are fortunate enough to receive awards.

Now I would like to turn your thoughts in a different direction. In my life, I have seen the proportion of our population growing food on farms shrink from 60% to 6%, with the displaced persons migrating largely to manufacturing. The next step may be for those in manufacturing to shrink from 60% to 6% for the same reasons, increased productivity. Many engineers will also be released from routine work by the amazing computing machines which the engineers themselves have helped to create. These new gaps can, of course, be closed by everyone working fewer hours. But I believe that engineering has the potentiality of and responsibility for creating new activities which will absorb much of the employment spread.

For example, the set of conditions which we call an economic depression, but which are more accurately described as catastrophic work famines for a few individuals and substantially normal times for the rest, are times when new projects which create new jobs are highly desirable if not essential and the engineer is definitely a creator of new jobs for new purposes as well as an eliminator of old jobs by increasing productivity.

And so, it is this creative phase of engineering which may be emphasized in the future. Thus, the picture of a man arriving at an air-conditioned office, sitting down in an upholstered chair, leaning back, putting his feet on the desk, closing his eyes and going to work—with his mind, of course—may become even more real than at present, or at least may become more symbolic of the phases of engineering which will be emphasized.

But, lest you conclude that this is all engineers may be good for in the future, I would like to point out that executive matters and company policy-making decisions, for example, are involving a more and more detailed knowledge of engineering matters, and that more people with not only engineering training but also with proved analytical and practicing experience will be involved in all phases of business.

And so I look forward to an almost unlimited future for engineering, and wish to thank the Committee again for being rewarded for my participation in the engineering past.

Career of Philip Langdon Alger

B. M. CAIN
FELLOW AIEE

ONE OF THE CHOICEST of pleasures is to document the achievements of someone whom we all have long admired. Today's occasion is an especially pleasant one for we are privileged to describe the brilliant careers of two such men. My acquaintance with Philip Alger began at the very start of my own engineering experience, and it has been my good fortune that the chain of events since then has kept me within the sphere of his activities.

During the past 40 years of tremendous advances in electric motor development, Philip L. Alger has been a dominant influence among motor designers and application engineers everywhere. His major contributions to the development of rotating electric machines have been in the critical areas of reactance calculation, the understanding and prediction of losses, and in the reduction of magnetic noise. The contributions which he has made in these fields have had a major impact on the evolution of rotating machines by bringing about reduction in physical size, the development of new applications, and improved performance. At the same time, even beyond his technical contributions, as a philosopher, writer and leader, his name has become a symbol of the professional engineer.

The starting point of today's events was January 27, 1894, when Philip Langdon Alger was born; a son of a Navy captain and professor of mathematics at the U. S. Naval Academy. Before the AIEE that year, Steinmetz and Pupin and others engaged in extensive discussions of the merits of the induction motor which Tesla had given to the world only a few years previ-

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ously. These men were laying the groundwork for the motorization of industry in which Philip Alger was to assume a leading role.

In 1912, we find the young mathematician receiving his B.S. degree from St. John's College. Then engineering called him to MIT where in 1915 he received his BSEE degree and a research assistantship to engage in the study of dynamo electric machinery.

During World War I, Mr. Alger became a lieutenant in the Ordnance Department, U. S. Army. There he distinguished himself by becoming interested in the cause of erratic trajectory of shells from a 6-inch Navy gun being tested under his direction. His studies, which led to a successful improvement, were published in the 1919 volume of the *Coast Artillery Journal*. After the war, he served as captain and then major in the Ordnance Department Reserve Corps from 1920 to 1943.

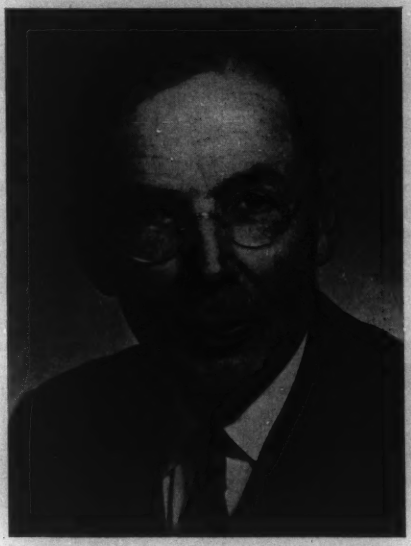
In 1919, Mr. Alger joined the General Electric Company and started work on the design of induction motors. The better understanding of reactance which he developed, together with other achievements led to a new assignment in 1924 in General Electric's A-C Engineering Department to work on synchronous motors. One of the problems was to simplify motor starting equipment. One of his accomplishments while working on induction motors had been to invent a new type of high impedance amortisseur winding, thus making it feasible to start motors directly across the line. Mr. Alger proceeded to adapt this new idea to the amortisseur windings of synchronous motors so that shortly after, for the first time in history, there became available synchronous motors which could be started directly across the line, without compensators.

In 1926, R. E. Doherty and C. A. Nickle presented the first of their famous papers analyzing the performance of synchronous machines. Mr. Alger undertook the enormous task of developing and assembling the circuit parameters for applying this analysis to actual applications. His 1928 AIEE paper "The Calculation of Armature Reactance of Synchronous Machines" remains a classic in the annals of rotating electric machinery.

During the 1920s, the double-winding turbine–generator was introduced to ease the duty on the circuit breakers. But the effectiveness of this scheme was greatly reduced as a result of saturation of the through reactance under fault conditions. Mr. Alger studied the effect of saturation in the alternate slot type of double winding and proposed the split-belt type of winding which has been used successfully since that time, in 37 large steam turbine–generators totaling almost 4 million kva.

In 1929, Mr. Alger was appointed to the staff of the vice-president of engineering to sponsor and co-ordinate developments in electric apparatus throughout the General Electric Company. He became a leader in professional engineering societies, in industry-wide standardization, in education, in local government as well as in technology. He was impressed by the observation that men are creatures of habit and he recognized that one must first have the wisdom to recognize what is sound and then have the courage to propose it, even when this means breaking with tradition. He developed the philosophy that "Rules are made to be broken—in a nice way."

His chief interests still lay in motors. He knew that for the greater expansion of the electrical industry, motors must be made smaller and lighter in weight for the same output. This task required the critical examination of many traditions in design engineering, in application engineering, and among the motor users. His published papers give only a glimpse of the extent of Mr. Alger's contributions as worker and leader of the committees and working groups of AIEE and ASA which led ultimately to the adoption of a succession of new NEMA standards for motors in the 1940s.



P. L. Alger

The motors of today, built to the new standards, weigh less than a third as much as their predecessors of the late 1920s, they are quieter, they do their jobs as well or better, and on an equivalent economic basis they cost much less. To gain an appreciation of the significance of these electric motors in our everyday life, one has only to count the number installed in his own home. My home has 38. And there is not one of these motors which has not, in one way or another, felt the influence of Philip Alger.

In the 1940s, many new synthetic insulation materials began to appear which could be used very effectively in electric apparatus, but their application was hampered by outmoded standards. Mr. Alger soon found himself pressed into leadership to challenge the old and make place for the new. As chairman of an AIEE working

group, he inspired the work which resulted in the preparation of the first test procedure for the evaluation of insulation systems for motors, published in 1954. The success of this work pointed to the need for a complete review of AIEE Standard No. 1, "General Principles Upon Which Temperature Limits Are Based in the Rating of Electric Equipment." Mr. Alger took a leading role in this important project and authored much of the material which paved the way for the use of insulating materials on the basis of their demonstrated properties.

In 1951, Mr. Alger returned to the induction motor department as consulting engineer. His influence and his services changed only to the extent that he concentrated his attention more on rotating machines.

One of the problems which he undertook was to investigate the causes of noise in induction motors. By inspiring others and by his own contributions, the entire picture of the noise relationships in electric motors was unfolded. Mr. Alger's AIEE paper "The Magnetic Noise of Polyphase Induction Motors" which appeared in 1954 is one of the most significant of the many contributions to this subject. In discussing this paper, a prominent engineer said "So far as I know, this is the first time anyone has undertaken to present an exact theory, with numbers, which would accurately set forth the amount of noise produced by an induction motor."

After extensive studies Mr. Alger devised a new system of connections for part-winding starting of induction motors. This system not only worked better but could be applied to standard induction motors taken out of stock at a great saving to the air conditioning and refrigeration industry. A series of AIEE papers, beginning in 1951, describe the progress of this work.

Mr. Alger has authored and co-authored some 80 published articles, usually on technical subjects. He has written two books "The Nature of Polyphase Induction Machines," John Wiley & Sons, Inc., 1951 and "Mathematics for Science and Engineering," McGraw-Hill, 1957.

Throughout his career Mr. Alger paralleled his technical work with equally vigorous pursuits in other fields. A registered professional engineer, he has worked tirelessly for higher standards in his profession. He is a past director and Member-for-Life of the AIEE and has been a chairman of six of its major committees. For years he was a representative of AIEE on the ASA C50 committee which sets the standards for rotating machines.

For the past 2 years, he has been chairman of the committee on Ethics of the Engineering Council for Professional Development. He has worked closely with the American Society for Engineering Education and the College Placement Council in the development of a manual: "The Principles and Practices of College Recruiting."

Quite early in his career he became interested in city government. Later, he became head of a movement which succeeded in installing the council–manager form of government for his home town of Schenectady. Never a seeker of office for himself, he has continued his vigorous activity in over a dozen civic, cultural, or social organizations. A member of Mr. Alger's family once observed that "It has taken him all his life to awaken to the fact that not everyone is as conscientious or hard working as he is."

Although mere words can never fully convey Mr. Alger's rich career, one engineer, his predecessor by a few years, has expressed it thus: "As I study the astonishing record of all the contributions of Mr. Alger, just one man, for the electrical industry, for the advancement of technical knowledge and for his fellow citizens, I wonder what our country could produce if all men were his equal in energy and mentality." And, so, it is with pride and admiration, that today we recognize the man whose work inspired those words by awarding to Philip Alger the Lamme Gold Medal "in recognition of his contributions to the art and science of design and application of rotating electric machines."

The Complete Engineer

P. L. ALGER
FELLOW AIEE

IZAAK WALTON'S whimsical book, "The Compleat Angler," opens with a debate between a hunter, a falconer, and an angler on the merits of their favorite recreations; and it goes on to describe in loving detail the arts of luring the wily trout with worm, or fly, or frog. The reader is beguiled along the way by many curious tales of nature's ways, as the description of a salmon leap:

> "Here when the labouring fish doth at the foot arrive,
> And finds that by his strength he doth but vainly strive,
> His tail takes in his mouth, and, bending like a bow
> That's to full compass drawn, aloft himself doth throw."

While Walton was writing, Cromwell's Ironsides were overcoming the Royalists, the head of Charles I was cut off, and across the channel the Thirty Years' War was ending. Walton mentions none of these events, nor does he refer to any emperors, rebels, or foreign devils, nor even to the poor. His only reference to science is his remark:

> "For angling may be said to be so like the mathematicks that it can ne'er be fully learnt."

Nowadays, there are too few trout streams to go around, and, anyway, most of us are too concerned with taxes, traffic, and turmoil around the world ever to aspire to become complete anglers. However, Walton's life spanned 90 years, and he enjoyed every minute of it,

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LAMME MEDAL WINNERS, first time in history of award that two persons have received it simultaneously, hold the award between them. Pictured left to right are: B. M. Cain (career of Mr. Alger speech), P. L. Alger, Sterling Beckwith, L. T. Rosenberg (career of Mr. Beckwith speech), and Mark Princi, who delivered the speech on the history of the medal.

even though he lived in a time of revolution and plague. What his book tells us is that we too may live long and happily, if we do well whatever we undertake, and if we acquire the art of savoring the good things in life as we go along.

It has been my observation that there are two chief, enduring sources of happiness. The first, of chief importance to the young, is the pleasure that comes from doing something better than the time before. Each new skill—to walk, to talk, to play, and to understand—is a thrilling experience. So long as each performance excels the last, the pleasure is intense. When a peak is reached and performance fades, the thrill goes too, and new skills must be developed:

> "To go up mountain's stony side
> I used to do with youthful pride
> But now I'd walk with slower feet,
> And pause to sniff the meadow sweet."

The second source of happiness, of chief importance to the old, is the "second degree" pleasure gained by seeing the joy of other people, especially that of friends and family. As one gains in awareness of the feelings of others, and extends the list of one's friends, this source of pleasure may increase without limit. However, ability to sympathize with the pleasures and pains of others is a skill that only civilized people have, and one that may develop quite late in life. I believe it was St. Thomas Aquinas who held out as a reward of virtue on earth the great joy of having a front seat in heaven to witness the tortures of the damned through all eternity. We have come a long way since that time, but it is still true that a great deal of pleasure for far away people is needed to overbalance a little suffering of one's own and vice versa.

This brings me to my theme: How in these days, can an engineer be most useful and have the most fun out of life? I take it for granted that liberal financial rewards will automatically follow.

The engineer devises structures, machines, and systems that will accomplish useful purposes; he designs them, and arranges for their construction with economy, celerity, and the firm assurance that they will have the desired performance, cost, and time of completion. In general, the engineer deals with known materials, methods, and scientific laws, but he must exercise wisdom and ingenuity in selecting, proportioning, and combining these in the most effective, harmonious, and economical ways to meet the desired ends. He must make accurate calculations, evaluate alternatives, and check his results thoroughly before construction starts. He must improvise, approximate, and invent as occasion demands, but above all he must be practical.

Houses, roads, bridges, cars, planes, ships, water supplies, electric power, and all the wheels and gadgets that we live by are due to engineers. Truly, as Kipling said, engineers are the sons of Martha:

> "It is their care in all the ages
> To take the buffet and cushion the shock.
> It is their care that the gear engages;
> It is their care that the switches lock.
>
> "It is their care that the wheels run truly;
> It is their care to embark and entrain,
> Tally, transport, and deliver duly
> The Sons of Mary by land and main."

From a professional viewpoint, the engineer is a middleman. The scientist discovers why and how things occur, and learns how other things may be made to occur. He also develops new materials and processes, which the engineer puts to use. Thus, the scientist has a glamor that the engineer lacks, and he performs a vital function that the public has come to value more highly than the prosaic functions of engineers. The lawyer provides the corporate forms, the legal means for cooperation and fair treatment of all contributions to the common cause, and the skill in dealing with people that are essential for large-scale enterprise. He and the entrepreneur who has the courage and stamina to undertake new ventures are likely to gain the highest rewards from society, but they also take the greatest risks.

Being in the middle, the engineer should not expect to gain either the acclaim given the scientist, nor the financial rewards of the business entrepreneur. But he

has the great satisfaction of being universally appreciated as a solid, reliable, and much-admired contributor to human well being and progress.

Recognizing all this, the engineer, while young and low down on the totem pole, should strive to learn all he can, gaining in depth and also breadth of knowledge as he goes on. There is a very great deal of fun and happiness to be gained in this process of learning and growing. The engineering art has so vast an extent, and is so rapidly developing, that there are unlimited opportunities to choose specific areas of knowledge, or types of work, that are to one's own liking. Since, at the higher levels, engineers must deal with men and money as well as material things, the young engineer with ability should not let the seat of his pants get shiny. He should speak at meetings, do a little teaching, read widely, and study economics, management, and history as well as pure engineering. And he should cultivate able friends and assistants who can take over, or share in, his growing responsibilities, as he rises in the profession. Many a good engineer has failed to win promotion because of his unwillingness to share his knowledge or to delegate responsibility to a younger man who might take his place. The man who is indispensable often is not promoted.

The experience of an engineer teaches honesty, since the laws of nature cannot be deceived, and ruthlessly expose the unfit. It also develops a co-operative spirit, since his large-scale projects require many specialists to work in harmony. Nowadays, when so many engineers are concerned with the development and operation of extensive systems, with problems of automatic control, stability, and adjustment to meet varied conditions, they have every opportunity to become experts in the organizing and delegating arts. Even though the lawyer, who deals with people from the beginning of his career, has a long headstart in the art of human relations, there is no reason why an engineer cannot gain superior skill in this field after 10 to 20 years of experience.

Thus, the engineer's technical skill, his reliability, his experience in teamwork, and his understanding of time and cost factors fit him admirably for leadership in large-scale human affairs. Year by year, more and more men with engineering experience are being chosen as managers, corporation presidents, and heads of all sorts of projects. However, the job of being a president or general manager transcends the pure engineering art, and carries with it onerous duties that few engineers would enjoy. And, the engineer who becomes a high-level executive must leave engineering work and decisions to others. Therefore, the engineer who aspires to reach the highest levels of service and recognition in his profession should seek to advise and guide the executives of large-scale enterprises, rather than to be a manager himself.

The United States Constitution provides for three distinct and independent branches of government—the Executive, the Legislative, and the Judicial. History suggests that no government of men can long endure unless these three branches are firmly established and independent, as pointed out by Montesquieu in his "Esprit des Lois" in 1748, and as recently demonstrated by the stability of the British, Swiss, and American governments, while dictators have fallen on all sides.

The reason that these three functions have been recognized in government is that governmental duties are so far-reaching that a sound organization is imperative. Now that business organizations are so extensive, they too must recognize this principle of an independent judiciary. The form this generally takes in practice, so far as the field of engineering is concerned, is to have various laboratories, standards committees, consulting engineers, and technical planning boards, usually under the direction of one or more vice presidents of engineering or science. The engineers who head up these activities of a large corporation serve as judges who interpret the laws of nature and decide what is right and practical to do. Woe be unto them if they yield overmuch to the competitive spirit, or commercial pressure, and accept unsafe stresses, unproved materials, or unsound designs.

Every engineer knows that he must preserve his independence of decision regardless of emotional appeals—just as the judge in a court of law must decide on the basis of the law and the evidence. The world at large does not understand this. It is not generally recognized that the engineering profession is even more exacting in its standards of morality and truth than the judicial profession—since nature's laws are inexorable and swift in their condemnation of faults in design. The bridge falls if the engineer fails to respect the strict laws of engineering, and with it goes the standing of the engineer.

Besides performing these judicial functions of deciding just how to build particular structures, the engineer has important duties in the planning field. Planning is a legislative function, but the engineer's advice is essential for sound conclusions. The engineer should foresee, suggest, and promote projects that will be most useful, practical, and economically feasible in the years ahead. Here too, the planner's duties are to advise, leaving to others the final decisions on what projects shall be undertaken and when.

If engineers with ability and experience recognize and live up to these duties of independent, decisive, judgments in technical fields, and of leadership in long-range technical–economic planning, they will surely gain high standing, great responsibilities, and commensurate rewards from business, Government, and society at large. In so doing, they may continue to make full use of their technical and scientific knowledge, in a way not possible if they become full-scale managers. In this way, too, they may expect to have the greatest possible amount of fun and satisfaction in life.

Wear Your ◆ AIEE Badge

Current Large Steam Turbine–Generator Design Practice

J. J. FLEISCHMANN

G. W. STAATS
MEMBER AIEE

THE BASIC INNOVATION which has allowed the continuing challenge to design steam turbine–generators of greater output to be met is the application of conductor cooling to large generators.

The large units as built by Allis-Chalmers are described as completely supercharged. One of the basic elements in supercharged ventilation is a device capable of developing enough pressure to circulate cooling gas through the various ducts in amounts sufficient to remove the heat generated without exceeding prescribed temperature limits. In large 3,600-rpm machines, this is a single-stage centrifugal blower. The gas leaving the blower spirals over the horizontal cooler sections with a minimum pressure drop and then enters the active parts of the machine. The stator core is cooled by axial ducts formed by punching holes in the laminations, and the stator coils are cooled by gas flowing in hollow tubes along the entire length of the coil halves. Gas is also admitted to both ends of the rotor core. Terminal bushings as well as stator phase connectors and machine leads are also ventilated, as are the collector rings.

Load tests on a typical large fully supercharged generator indicate the effectiveness of conductor cooling for large machines. Stator heating as measured by thermocouples on the coil strands agrees well with that measured by embedded detectors, indicating low thermal gradient through the coil insulation. The comparison is shown in Fig. 1.

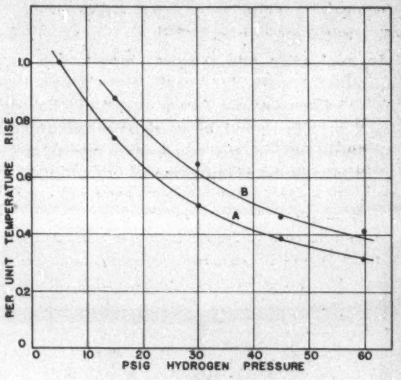

Fig. 1. Stator heating curves from test.
A — Rise by embedded detector
B — Rise by strand thermocouple

In addition, 1,800-rpm generators over 200 mva are being completely supercharged, using a ventilation system essentially the same as for 3,600-rpm units but employing an axial compressor.

Stator windings of large generators have their strands transposed by means of a 540-degree transportation. Flux traps composed of rings of grain-oriented steel surrounding the stator coil ends are also incorporated in the design of these machines. This combination reduces eddy current losses, thus resulting in lower hot-spot temperatures which, in turn, reduce the hazard of tape separation.

Vibration is minimized by careful supervision of manufacture and design to avoid resonance of parts to operating frequencies. Factory balancing is performed in a hot balance pit in which temperatures can be controlled to simulate maximum operating temperatures.

Stators are constructed of a strong and rigid outer frame designed to avoid resonance of the complete yoke and any of the internal plates with operating frequencies. Cores of all 3,600-rpm units have a flexible support, whereas the laminations of 1,800-rpm machines are stacked directly on the dovetail bars fastened to the outer frame. Inner-core vibration has been measured during factory tests and found to be very low.

There has also been continued rapid progress in the refinement of design and inspection of rotating elements. More complete evaluation of ultrasonic and other inspection techniques has been made possible by the results of field experience and other investigations. The quality of forgings is being improved. The requirement of rotor preheating has been lifted on most units.

Rotor-coil support rings are made from nonmagnetic solution-treated austenitic steel, cold worked to develop high strength while maintaining ductility.

The simplified hydrogen seal system takes its normal supply of oil from the shaft-driven turbine oil system. With this system, it is not necessary to vacuum treat the oil. A thrust-type seal is used in which the major portion of seal oil flows through the seal to the air side without coming into contact with hydrogen. Hydrogen control equipment and the scavenging procedure are designed to insure safe and reliable operation together with high gas purity.

Test data on typical machines indicate that these units are low in losses. Operation at higher hydrogen pressures is also proving feasible, with desirable characteristics indicated. Further improvements in design and manufacturing methods are expected to make possible still higher efficiencies and greater dependability for the larger capacities of the future.

Digest of paper 58-1109, recommended by the AIEE Rotating Machinery Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE–ASME National Power Conference, Boston, Mass., Sept. 29–Oct. 1, 1958. Published in AIEE *Power Apparatus and Systems*, Feb. 1959.

J. J. Fleischmann and G. W. Staats are with the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

A 10,000-Kva Gas-Insulated Transformer—A Progress Report

G. CAMILLI
FELLOW AIEE

An evaluation and progress report of a gas-insulated transformer recently put into operation at the Pennsylvania Power and Light Co. This type of transformer offers definite advantages to the utility industry which must participate in its development to realize its full potential.

Fig. 1. GE's 10,000-kva, 69,000-12,470 volt, gas-insulated (SF_6) transformer, installed at the Pennsylvania Power & Light Company's system at Allentown, Pa.

INTEREST in gas-insulated transformers with sulfur hexafluoride (SF_6) on the part of utilities and industrial application engineers is increasing. An increasing number of units are being manufactured since the delivery in 1956 of two 2,000-kva, 69-kv transformers to the Consolidated Edison Company of New York. Apparently, the fire and essentially explosionproof characteristics of this type of equipment are of real interest to the electrical industry.

The most obvious use of gas-insulated units seems to be in the indoor or underground installations and in substation transformers located in congested areas. These transformers may be economical and desirable also in generating stations both as the main step-up and station auxiliary units.

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For all these applications, the use of gas instead of liquids as the insulating medium offers sufficient advantage during the initial installation and in the reduction of subsequent operation and maintenance expenses to offset a somewhat higher first cost. Some day, when volume production, field experience, and know-how is increased, there may be no reason why gas-insulated units will not be practical for any power transformer application.

In order to be of some help in the evaluation of this type of equipment, we wish to present in the form of a progress report the design features and the performance characteristics of a 10,000-kva 69-kv gas-insulated transformer recently built and now in operation at the system of the Pennsylvania Power and Light Company at Allentown, Pa.

This transformer is rated 10,000 kva, 60 cycles, 62,700-12,470Y/7,200 volts.

GENERAL APPEARANCE

AS IS SHOWN IN FIG. 1, the external appearance of this unit is somewhat unusual and does not resemble that of a conventional oil-filled unit. The reason for this is that with the gas under pressure, a cylindrical tank is ideal as a pressure vessel.

With the exception of the manholes, an all-welded construction has been used. The tank has been designed and tested to meet the ASME (American Society of Mechanical Engineers) pressure vessel codes.

GASEOUS INSULATION

SULFUR HEXAFLUORIDE[1] (SF_6) is used as the insulating medium at a nominal pressure of 15 pounds per square inch gauge (psig) at 25 C. This gas is nonflammable and nontoxic. In addition, this gas has a very low boiling point making it suitable for units to be operated outdoors and it is readily available commercially at a reasonable price.

During the operation of the unit (heating and cooling cycles), the pressure will follow the relationship shown in Fig. 2 with no changes in the dielectric strength because the dielectric strength depends upon the density (fixed by the initial filling) of the gas, and the density of the gas will remain constant in a sealed tank.

THE CONSTRUCTION OF THE CORE AND COILS

WITH THE EXCEPTION of minor modifications in the insulating structures, the core and coils are of the conventional type (Fig. 3) similar to those used in oil-filled

units. Likewise, Class A insulating materials have been used for the conductors and the supporting members of the core and coils.

COOLING

THE COOLING is obtained by forced circulation of the gas through the core and coils, as is shown schematically in Fig. 4. Two independent blowers are used for this purpose. The motors for the operation of the blowers are enclosed in two separate chambers which are also independent of the main tank so that the motors and the auxiliary bearings of the blowers can be inspected without loss of gas from the transformer.

A two-stage evaporative cooler has been developed and is used for the cooling of the gas. Referring to Fig. 4, the insulating gas after being heated by passage through the core and coils flows over an "evaporator" *A* which is located in the main transformer tank. The evaporator is connected to a condenser *B* which is located externally to the unit. The system contains a freon liquid. When the transformer is in operation, the heated SF_6 gas produces the evaporation of the freon in the evaporator. The vapor rises into the "condenser," where it liquifies under the action of the external air (fan) and then returns to the evaporator. The circulation is accomplished by gravity without the action of any mechanical help.

There are many advantages in the use of this system: the condenser can be located in any convenient place even remote from the transformer; it can be shipped separately from the main unit without loss of gas pressure, and it is smaller than a conventional tubular gas-to-air cooler.

INSULATION CHARACTERISTICS

IT IS RECOGNIZED that the insulation characteristics of gas-insulated transformers differ from the conventional oil-insulated units: the volt-time curve of a gas structure in general does not show the bending up at the shorter times (less than three microseconds) that is obtained

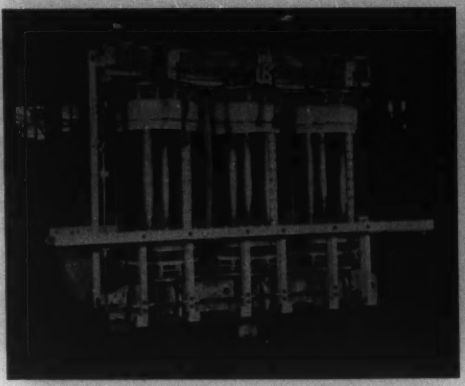

Fig. 3. External view of the core and coils, 10,000 kva unit.

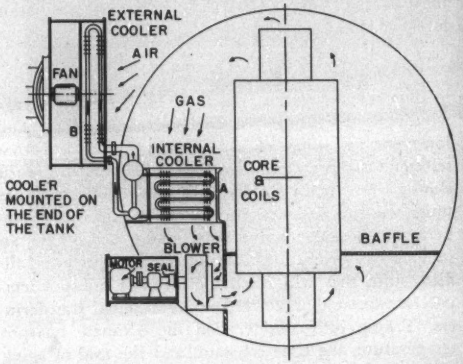

Fig. 4. Two-stage evaporative cooling system used for the cooling of the gas.

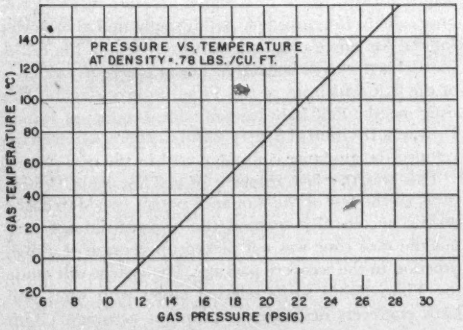

Fig. 2. Pressure vs temperature characteristic of sulfur-hexafluoride at constant volume with a density of 0.78 pound per cubic foot.

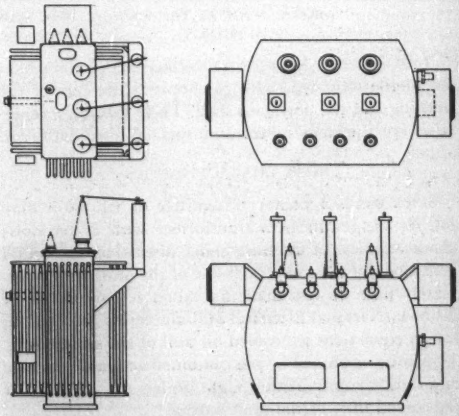

Fig. 5. Comparative sizes of oil (*left*) and gas-insulated transformers, both rated 10,000 kva, 69 kv.

from an oil-insulated structure. At the same time, gas-insulated structures have a flatter volt-time characteristic at the frequencies of switching surges than oil-insulated structures. It has been shown[2] that the improved characteristics of the modern Magne-valve type arresters seem well suited for the protection of gas-insulated transformers throughout the frequency spectrum. In accordance with the proposal presented to the Institute a year ago,[2] the high-voltage windings of the 10,000-kva unit under discussion have been protected with lightning arresters connected directly to the high-voltage bushings and under these conditions a very good margin of protection is obtained, although the basic impulse level is one step below the conventional level established for oil-insulated units. In accordance with the same proposal, full low-frequency tests were applied to both high-voltage and low-voltage windings. The low-voltage windings are not protected with lightning arresters and are designed and tested with the corresponding full BIL (basic impulse insulation level) at 110 kv.

OPERATING TEMPERATURES

THIS PRESENT UNIT was designed to have an average winding temperature rise for both high-voltage and low-voltage windings of 55 C. However, it appears that selected Class A materials will age in SF_6 gas at a much slower rate than in no. *10-C* oil, and, therefore, future units will be designed for operation at higher temperature. Because gas-insulated transformers have an inherently shorter time constant than an equivalent oil-filled unit, they will reach the ultimate hot-spot temperature faster than corresponding oil-filled transformers. Taking into consideration the ultimate hot-spot temperature, the time constant, and the rate of aging of insulation, the overload capabilities of gas-insulated units are approximately equivalent to those prescribed by the American Standards Association for forced-oil-cooled units.

BUSHINGS

THE BUSHINGS for the transformer under discussion are of the solid type with gas between the core of the bushing and the porcelain shell. These bushings, otherwise, are the same as conventional oil-filled bushings.

NOISE CHARACTERISTICS

SINCE GAS is a poorer transmitter of vibration than oil, its use results in a transformer with better noise characteristics. In the unit under discussion, the sound generated by the core (exclusive of the fans) is approximately nine db less than the values recommended by NEMA (National Electrical Manufacturers Association) for an equivalent self-cooled oil unit of the same rating. The noise emanated by the combined action of the core and fans is approximately eight db less than equivalent fan-cooled unit of the same rating.

Comparative data shown in Table I may be of interest.

Table I. Comparison with Oil-Filled, Self-Cooled Unit of the Same Rating

Item	Oil-Filled Self-Cooled Unit	Gas-Insulated Unit
Weight of core and coils	88%	100%
Weight of insulating medium	2,200%	100%
Total weight of units	140%	100%
Reactance	7.2%	7.2%
Total loss	95%	100%
Relative size and floor space	See Fig. 5	See Fig. 5

CONCLUSIONS

THE 10,000-kva gas-insulated transformer just described is the third unit, now in service, manufactured by the company with which the author is associated. Several additional units, some of higher kva and higher voltage, are under construction. Although much remains to be done before this new equipment will be competitive in every respect with liquid-insulated units, the development is progressing and the results have been consistent and encouraging.

It is believed that gas-insulated transformers offer definite advantages to the utility industry. How well and how soon their potentials will be realized will depend to a large extent on the participation by the electric utilities in this development.

REFERENCES

1. Gas-Insulated Transformers, G. Camilli. *General Electric Review*, May-July, 1956, pp. 41-4.

2. Insulation Co-ordination of Gas-Insulated Transformers, G. Camilli, R. E. Coates. *AIEE Transactions*, pt. III, vol. 77, June 1958, pp. 220-24.

Titan Guidance System

The recent rapid recovery in the South Atlantic of the nose cone from a U. S. Air Force Thor-Able II missile, fired earlier at Cape Canaveral, Fla., was achieved through use of a highly accurate missile guidance system. Developed by Bell Telephone Laboratories for the Air Force's Ballistic Missile Division, the radio-inertial system will be used to insure precision guidance of the first squadrons of the Titan intercontinental ballistic missile. Bell Labs teamed with Remington Rand–Univac, a Division of Sperry Rand Corporation, who developed the guidance computer used in the new system.

This was the first recovery of a Thor–Able II nose cone. In the test of the guidance system last March, the missile successfully reached the selected impact area but the nose cone was not picked up because of a malfunction in the recovery package. The system will guide the Titan ICBM to its selected target with what Bell Labs engineers describe as "pinpoint accuracy." This particular system determines, at the ground guidance station, the position and velocity of the missile and calculates the exact spot of nose-cone impact.

Natural and Artificial Voids in Insulation

S. I. REYNOLDS

Fig. 1. Photograph of liquid droplets on void surface of natural void specimen at 90 × magnification.

Fig. 2. Erosion of surface on polyethylene terephthalate insulation after a number of hours under ionization.

A HIGH VOLTAGE Schering bridge with broadband differential amplifier and cathode-ray oscillograph were used to check the onset and offset of ionization as well as the change in conduction caused by surface effects within the void.

Comparisons of calculated and measured inception voltages for natural voids and artificial voids in polyethylene show initially that the discharge inception voltage of natural voids takes place at two to three times the calculated value, where artificial voids of the same material ionize at or close to the calculated value. It has been observed in many instances that if the voltage is applied at twice the calculated inception value of a natural void, ionization will often start in periods ranging from 10 minutes to longer than 1 hour.

Physical examination of the inside of natural voids in polyethylene after a few hours of ionization reveal droplets of liquid scattered over the surface as shown in Fig. 1. The appearance of these droplets is associated with deterioration products from the void surface caused by ionization.

Tests on polyethylene terephthalate (Mylar) insulation with artificial voids having the same dimensions as in polyethylene showed a more rapid degradation than in polyethylene. As shown in Fig. 2, erosion of the surface occurs after a number of hours under ionization. This eroded surface has a conduction value of 30 times 10^{-11} mhos compared to 6 times 10^{-11} mhos for same size void in polyethylene. This conduction is sufficient to prevent ionization at twice its initial inception value.

In summary, this investigation indicates that moisture plays a major role in the degradation in sealed voids within a dielectric system. Surface conduction changes within a closed void caused by chemical deterioration have a major effect on the ionization behavior of natural voids under voltage stress.

Observed lateral field tracking on both Mylar and polyethylene specimens of laminated construction is an important subject for further study.

Digest of paper 58-1186, "On the Behavior of Natural and Artifical Voids in Insulation Under Internal Discharge," recommended by the AIEE Electrical Insulation Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Pittsburgh, Pa., Oct. 26-31, 1958. Published in AIEE *Power Apparatus and Systems*, Jan. 1959.

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The Institute and Its Operations

III. Intersociety Affairs

L. F. HICKERNELL
PRESIDENT AIEE

In this third and concluding article in a series written to acquaint the membership at large with Institute functions, President Hickernell describes our relations with other societies, and AIEE's position with regard to the increasing demands for unity of the engineering profession.

FORMED in an atmosphere of intersociety co-operation, AIEE held its organization meetings in 1884 in rooms loaned by the American Society of Civil Engineers in New York City. The Institute has maintained close relationships with other engineering societies throughout its initial 75 years.

REPRESENTATIVES

In all, AIEE has been formally represented on 105 intersociety units. **Table V** shows current representations, grouped according to the Departments to which they are assigned for administrative purposes.

MEDALS AND AWARDS

The first formal joint organization of the major engineering societies for a common purpose was the formation in 1902 of a Board of Award to administer the John Fritz Medal, the highest honor bestowed by the profession in the United States. Mr. Fritz himself was presented the first Medal at a dinner celebrating his 80th birthday, August 21, 1902.

Table VI shows the medals and awards conferred jointly by AIEE and other engineering societies.

ENGINEERING SOCIETIES BUILDING
United Engineering Trustees, Inc.

The first Institute Secretary's report[19] in 1885 stated that a Joint Committee on Union Engineering Building was studying the problem of securing a "permanent, handsome, and fireproof structure" to provide office space and meeting rooms, and house libraries and museums for the scientific and artistic societies of New York.

The Latimer Clark* collection of 7,000 volumes of early electrical literature was presented to AIEE[20] in 1901 by S. S. Wheeler (President, 1905-06), contingent upon provision within 5 years of a permanent building in which to house it. (This now priceless collection was cataloged with funds provided by Andrew Carnegie.) The Building Committee was thus faced with a deadline. The success of the engineering societies' co-operative effort in founding the Fritz Medal was reported to have been "highly inspirational" to the Building Committee.

The second week in February 1903 was perhaps the most important in the history of the engineering societies as a group.

On Monday, February 9th, AIEE held a dinner meeting. Andrew Carnegie was in attendance, having declined six times, then accepted the seventh invitation.[21] President C. F. Scott (1902-03) mentioned in his address that engineers had created great wealth, but

Table V. AIEE Representations—1958-59

	Year Initiated
Board of Directors	
1. AIEE–IRE Coordination Committee	1957
2. Conference of Representatives from Engineering Societies of Western Europe and United States (EUSEC)	1950
Administration Department	
3. AIEE–IRE Coordination Committee on Student Activities	1950
4. American Association for the Advancement of Science, Council	1908
5. Construction Industry Advisory Council	1944
6. Electrical Historical Foundation Board	1958
7. Engineers Joint Council, Board of Directors	1946
8. Library Board—United Engineering Trustees, Inc.	1912
9. United Engineering Trustees, Inc.	1905
Professional Development and Recognition Department	
10. Volta Scholarship Trustees	1927
11. Engineers' Council for Professional Development	1931
12. John Fritz Medal Board of Award	1902
13. General Electric Educational Fund Fellowship Committee	1922
14. Hoover Medal Board of Award	1929
15. Kettering Board of Award	1957
16. Marston Medal Board of Award	1938
17. National Bureau of Engineering Registration Advisory Board	1933
18. Alfred Noble Prize Committee	1929
19. Sperry Board of Award	1955
20. Washington Award Commission	1916
Publications Department	
21. Atomic Energy Advisory Committee on Industrial Information	1954
22. Engineering Societies Monographs Committee	1930
Technical Operations Department	
23. American Automatic Control Council	1957
24. American Standards Association, Standards Council	1934
25. Engineering Foundation Board	1916
26. International Commission on Illumination, United States National Committee	1913
27. National Association of Corrosion Engineers, Intersociety Committee on Corrosion	1939
28. National Bureau of Standards Advisory Committee	1956
29. National Electronics Conference, Board of Directors	1947
30. National Fire Waste Council	1923
31. National Research Council, Division of Engineering and Industrial Research	1918
32. World Power Conference, United States National Committee	1943

*Josiah Latimer Clark (1822-98), electrical engineer, submarine cable expert, and inventor. Demonstrated "Faraday effect" in 1853 before Faraday. Active in establishing standards of electrical measurement. President of IEE, 1889. Collected Library for 50 years.

Full text of an address presented in abstract at the South East (No. 4) and South Central (No. 13) District Meeting, Atlanta, Ga., April 8-10, 1959; East Central (No. 11) District Meeting, Akron, Ohio, April 22-24, 1959. Empire (No. 1) District Meeting, Syracuse, N. Y., April 29–May 1, 1959; Middle Eastern District (No. 2) Meeting.

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were still without a home. He envisioned a fine "capitol of engineering" wherein engineers would join in a congress devoted to the public interest.

On Tuesday, Mr. Carnegie invited President Scott and Calvin W. Rice, chairman of the Building Committee, to his home. He asked to see the plans for the proposed building. This was a little awkward, because there were none, there having been nothing upon which to base them. Scott and Rice agreed to counsel quietly with a few others and return with plans.

On Wednesday, 11 unofficial representatives of the American Society of Civil Engineers (ASCE), American Institute of Mining Engineers (AIME), American Society of Mechanical Engineers (ASME), AIEE, and the Engineers' Club held a meeting, and concluded that cooperation among the societies in such a venture would indeed be feasible.

On Saturday, February 14, 1903, Andrew Carnegie returned to his home from a round of golf to find President Scott and five others waiting with the plans, which were typed on a single sheet, and showed the estimated cost of the building to be $1.2 million. Mr. Carnegie looked the plans over, discussed them briefly, and said, "What is to prevent closing this up right now?"

He then penned his famous note to the four Societies and the Engineers' Club, which read:

> It will give me great pleasure to give, say, one million dollars to erect a suitable Union Building for you all, as same may be needed.

The months that followed saw intensive activity in the development of building plans. Legal procedure had to be worked out by which several societies could own and operate a building. ASCE, its own building only six years old, declined to join at that time. However, many smaller engineering and scientific societies requested quarters in the proposed building.

On March 14, 1904, Mr. Carnegie wrote a second note to AIME, ASME, AIEE, and the Engineers' Club, in which he offered $1.5 million to erect a building for them in New York City. The half million dollar increase was won by means of one of the most diplomatic letters ever penned. Written by AIEE President Scott to Mr. Carnegie, it discussed progress toward obtaining property, and contained a revised upward estimate of the cost of the building. In the last paragraph Scott wrote:

> If these general plans meet with your approval, and it is your pleasure, we should like to have assurance from you that the words 'say, one million dollars,' expressed in figures, may mean about $1,500,000.

Both the general plans and Scott's presentation met with Carnegie's approval. On March 18, 1904, Scott was elected chairman of the Engineering Building Committee, successor to the Joint Committee.

The United Engineering Society (UES), a joint holding corporation, was created in May 1904 to administer the building, and for the "advancement of engineering arts and sciences in all their branches, and to maintain a free public engineering library." Estimates were obtained for two homes and funds were allotted, giving the Engineering Societies $1,050,000 (70%), and the Engineers' Club $450,000 (30%).

The site on 39th Street was acquired in December 1904 for $540,380, parcels having been purchased and assembled previously by an agent for Mr. Carnegie. The Institute established a quota of $200,000, and set about raising funds. Considering the value of the dollar then, and that Federal income taxes were not to come into use for another 14 years, some very handsome

Table VI. Joint Society Medals and Awards

Title	Established	Societies	Sponsored by	In Honor of	Field of Achievement
Fritz Medal*	1902	AIEE-AIME-ASCE-ASME	Friends of John Fritz	John Fritz	Science or industry
General Electric Educational Fund Scholarship*	1922	ASME-APS-ACS-AIEE-ASEE-NAS	General Electric Co.		(30 graduate fellowships)
Hoover Medal§	1929	AIEE-AIME-ASCE-ASME	Conrad N. Lauer	Herbert Hoover	Distinguished public service
Kettering Award§	1956	AIChE-AIEE-AIME-ASCE-ASME-SAE	Friends of C. F. Kettering	C. F. Kettering	Creative accomplishments within relationships of materials and energy
Marston Award*	1938	AIChE-AIEE-ASCE-ASME-Iowa State College	Iowa State College	Anson Marston	Engineering achievement within broad field by alumnus of 30 or more years
Noble Award*	1929	AIEE-AIME-ASCE-ASME-Western Society of Engineers	Friends of Alfred Noble	Alfred Noble	Technical paper authorship by society member under 31 years of age; paper published by society
Sperry Award*	1955	AIEE-ASME-SAE-SNAME	Sperry Family	Elmer A. Sperry	Engineering contribution advancing art of transportaton (to individual or group)
Volta Scholarship*	1927	AIEE-Italian Electrotechnical Association	Italy-American Society of New York	Alessandro Volta	(1-year United States scholarship to young Italian electrical engineer of outstanding ability)
Washington Award*	1916	AIEE-AIME-ASCE-ASME-Western Society of Engineers	John W. Alvord	George Washington	Merit in promoting public good

*Annual Award
§Periodic Award

contributions were obtained. $5,000 individual contributions were given by Thomas Edison, Elihu Thomson, C. A. Coffin, C. W. Mackay, M. I. Pupin, and others.

Design and architecture were selected by competition, 26 sets of drawings having been submitted. Old residences on the land were removed in 1904. The building contract was signed in July 1905. Mrs. Carnegie laid the cornerstone in May 1906.

The United Engineering Society first met in its new home in November 1906. The building was completed on December 1st, and UES assumed management December 15th. The first AIEE meeting in the building was held in the auditorium in January 1907. Institute offices were occupied in February.

The financial panic of 1907 affected contributions to the "Land, Building and Endowment Fund," and a mortgage was necessary, which amounted to $54,000 when it was liquidated from surplus in 1915.[22]

ASCE became the 4th "Founder Society" in 1916. For their occupancy in November 1917 three stories were added at a cost of $300,000, of which ASCE provided $262,500 and the other three societies $12,500 each.[23]

United Engineering Societies became Engineering Foundation, Inc., on January 1, 1930, and a year later assumed its present name, United Engineering Trustees, Inc (UET).

The American Society of Chemical Engineers (AIChE) became the fifth Founder Society by joining UET in May 1958 with a down payment of $50,000 and assumption of financial responsibilities commensurate with the investment of the other four societies.

NEW UNITED ENGINEERING CENTER

For some 50 years, we enjoyed the benefits of Carnegie's magnificent gift, but now the building has become obsolete, and is no longer adequate to our needs. In the intervening years, death claimed our benefactor, and a tax system evolved which precluded another of his talents attaining a like position of affluence. We are on our own.

The current fund-raising campaign is more than the phrase implies. By it, we achieve a giant step forward in establishing the right to eminence of our profession, or we show ourselves plainly not equal to the challenge of the day.

In 1904, there were some 3,000 Institute members. Even in the face of a financial panic, they managed to raise $150,000 for the purchase of land. Surely we—now 54,000 members—can raise our quota of $900,000, and do our part to bring into reality the United Engineering Center (UEC).

The UEC will be located diagonally across the street from the United Nations, a focal point of world attention which attracts more than 1 million visitors annually. The Center will be a source of pride and improved service to members of the engineering societies. But more than that, it will be a symbol of unity of purpose among engineers in which our country, too, can take pride.

GENERAL SERVICES

The Institute co-operates with the Founder Societies in the maintenance of general services to the membership.

The **Engineering Societies Library**, a combination of the libraries of the first four Founder Societies, contained as of September 1958, more than 177,000 volumes, 24,000 maps, 5,700 translations, and some 10,000 bibliographies and indexes. It receives 1,000 English and 500 foreign language periodicals. The Library Service Bureau maintains a staff for abstracting, translating, compiling bibliographies, conducting searches for statistical reports and patents, copying, preparing reference cards, etc.

The **Engineering Foundation** was founded in 1941 with Ambrose Swasey's generous gift of $800,000 to "engineering in general, . . . research in particular." Other contributions and bequests have been added to form a modest endowment fund, the income of which is used for research projects. Because of its comparatively small resources, the Foundation has had to use a "seed money" technique; that is, make its grants contingent upon larger contributions from other sources. The Foundation provides an effective means of developing our young scientists and engineers. It is regrettable that it has not attracted more philanthropists.

The **Engineering Societies Personnel Service, Inc.**, is a nonprofit organization which assists members of the Founder Societies to secure or fill positions. The Service has offices in New York, Chicago, and San Francisco.

A **Historical Museum** was established in the Engineering Societies Building, but its space was consumed within a few years by the library. Some very valuable historical items, such as the original Stanley transformer, await suitable space in the new UEC.

ENGINEERS COUNCIL FOR PROFESSIONAL DEVELOPMENT

A Joint Conference on Certification, attended by representatives of seven national engineering societies including AIEE, was held in October 1932. One of the Conference's recommendations was the formation of the Engineers Council for Professional Development (ECPD), ". . . to advance the engineer professionally through the co-operative support of those national organizations directly representing the professional, scientific, educational and legislative phases of the engineer's life."[24] The ECPD was formed immediately.

Currently, ECPD concerns itself primarily with education and development of young engineers, establishment of standards for engineering education, accreditation of engineering curricula, and canons of ethics. These activities are mainly the outgrowth of AIEE President W. E. Wickenden's (1945-46) repeated exposition of the responsibilities of the professional societies in the educational field.[25] Wickenden's papers are included in ECPD's basic reference manual.

ECPD's outstanding accomplishments over a 26-year period are another example of the ability of engineers to co-operate in a common, well-defined cause.

THE TREK TOWARD UNITY

Thus far, the intersociety matters discussed have been instances of co-operation for mutual benefit for specific purposes, with each society retaining complete independence. There is also a second form of intersociety activity directed toward establishment of a single overall organization which will represent the profession of engineering in much the same way that the American Medical Association and the American Bar Association represent the professions of medicine and law. The proponents of unity find the trek toward this goal agonizingly slow. There follows a brief review of steps taken until June 1959.

The Engineering Council.

The Engineering Council was formed in October 1916 as a department of the United Engineering Societies. The Council consisted of five representatives from each of the four Founder Societies and UES. Its object was:[26]

> To provide for the convenient cooperation between the Founder Societies, for the proper consideration of questions of general interest to engineers and to the public, and . . . for united action upon questions of common concern to engineers.

American Engineering Council.

The American Engineering Council (AEC) was organized in November 1920. Affairs of The Engineering Council were transferred to AEC in January 1921. Objects of the AEC were:

> 1. To further the public welfare wherever technical and engineering knowledge and experience were involved.
> 2. To consider and act upon matters of common concern to the engineering and allied technical profession.

Herbert Hoover, then Secretary of Commerce, was the first President of AEC.

AEC operated effectively until 1934 when the depression caused drastic reduction in contributions from member organizations, with corresponding reductions in program and personnel. AEC membership ranged from 19 national, state, and local societies to 54 at the time of its dissolution in December 1940. The AEC collapsed when three of its largest contributing societies withdrew within a period of 5 months. The corporation has been continued, preserving the name "American Engineering Council." Its funds were turned over to the Engineers Joint Council in 1949, to be held in trust.

Engineers Joint Council.

The Engineers Joint Council (EJC) was formed in 1941 "to consider joint efforts in national defense." Officers of the Founder Societies composed the Council. First called the "Joint Conference Committee," then the "Engineers Joint Conference," it assumed its present name in 1945, when a constitution was adopted.

During 1943-44, each member society appointed three representatives to a joint committee "to study and recommend a plan for the organization of the engineering profession."

In 1947, AIEE proposed an "American Engineering Association" with individual membership. EJC appointed a Committee on Unity to consider AIEE's report and other suggestions. The Unity Committee recommended that an exploratory conference of representatives of the larger national engineering societies be held.

The Exploratory Conference, held in October 1949, found general agreement that some steps toward organizing for increased unity was desirable, but reached no conclusion on the form such an organization should take. It was felt that approach should be for closer cooperation among existing organizations with modification, perhaps grouping of some of them, rather than establishment of an entirely new society.

A Planning Committee was appointed from among members of the Exploratory Group to study increased unity. The Committee prepared an extensive report which, in December 1950, was adopted for discussion by the Exploratory Group. The report included four plans:

> A. **EJC Plan,** called for the expansion of EJC to include other societies. Individuals would not have direct representation, but automatically would belong through membership in the component societies.
>
> B. **Modified EJC Plan,** called for EJC expansion to include other societies and also to provide for voluntary individual membership.
>
> C. **Merger Plan,** called for merger of EJC and the National Society of Professional Engineers (NSPE), and expansion to permit representation of the entire engineering profession.
>
> D. **NSPE Plan,** called for adoption of NSPE as the unity organization with expansion of its membership and activities with the co-operation of other societies. Modification of NSPE's entrance requirements would be necessary, as only registered engineers were eligible for membership.

The report was distributed among the 15 societies constituting the Exploratory Group, and was discussed widely for a year.

In December 1951, a majority of the Exploratory Group adopted a report[27] recommending that ". . . a unity organization be organized first by the development of EJC along the general lines of Plan A . . ."

In January 1952, this report, together with a minority report by NSPE, was transmitted to EJC and the Exploratory Group societies.

EJC modified its constitution in November 1952 to admit other than the five Founder Societies, and to provide for representation from the Constituent Societies proportional to their membership.

In December 1952, EJC extended membership invitations to eight additional societies. Responses were:

	1952 Voting Membership (approximate)
Accepted	
American Society for Engineering Education	7,500
American Water Works Association	8,400
Society of Naval Architects and Marine Engineers	5,400
Did Not Accept	
American Association of Engineers	6,100
American Society of Heating and Ventilating Engineers	5,900
Institute of Aeronautical Sciences	4,400
Institute of Radio Engineers (IRE)	8,200
National Society for Professional Engineers	24,200

The last two gave specific reasons for refusal.

IRE cited[28] two basic policies:

"(1) IRE shall not engage directly or indirectly in legislative activity.

"(2) IRE, as a society, is not entitled to represent its members as individual members of the engineering profession or as a body in social or general professional matters, and shall not, as a society, take a stand even on technical matters."

NSPE stated[29] that

". . . at this time, in accordance with the firm conviction of this Board, no organization can adequately represent the engineers of this nation, unless that organization is based primarily upon individual membership and constituted to assure prompt and effective means of communication between the individuals, their local or state units and their national governing body."

In February 1958, the EJC President suggested that each Constituent Society appoint a Committee to Study EJC "as an Inter-Society council or organization through which common problems of the entire profession can be dealt with most effectively . . ."

In August 1958, the EJC Review Committee of ASME recommended that EJC and ECPD be consolidated into an "American Engineering Association" (AEA). It is proposed that NSPE be urged to join as a Constitutent Society on the same basis as the Founder Societies and other members of the present EJC and ECPD. Also, it proposed that the AEA be divided into three Divisions: Educational, Technical, and Professional.

In October, a Joint EJC–ECPD Committee was formed to study the possibilities of a merger, and means of implementation. Each Council appointed three members, none of whom repersented the viewpoint set forth by AIEE.

In November 1958, the EJC President convened a meeting of the Joint Committee with four members, two from each Council, in attendance. At the meeting, the Committee concerned itself only with means for implementing a consolidation, *ipso facto*. No consideration was given to any possible disadvantages of a merger, especially to ECPD, which is named specifically in 41 of the 54 registration acts of legislatures.

Amendment of the EJC Constitution requires an affirmative vote of two thirds of the present 11 Constituent Societies, or 8 votes. Change in the ECPD Charter requires approval by two thirds of the present eight Participating Bodies, or six votes.

The Institute's Position.

AIEE has taken part through the years in formulating and discussing plans aimed at the unification of the engineering profession. It has established a definite policy, the Functional Plan, has published that policy, and presented it to other societies for their consideration. There follows a brief review of the actions taken by the Institute which led to the Functional Plan.

President W. E. Wickenden (1945-46), instigated a study of the Institute's adequacy to meet the needs of its members, and its relations with the profession at large. The Planning and Coordination Committee, to whom the assignment was given, formed a Professional Activities Subcommittee, which undertook the study and formulated four proposed plans for organizing the profession. These were discussed at an Institute Activities Conference in January 1946, revised, and published in *Electrical Engineering*, April 1946. The plans were designated:

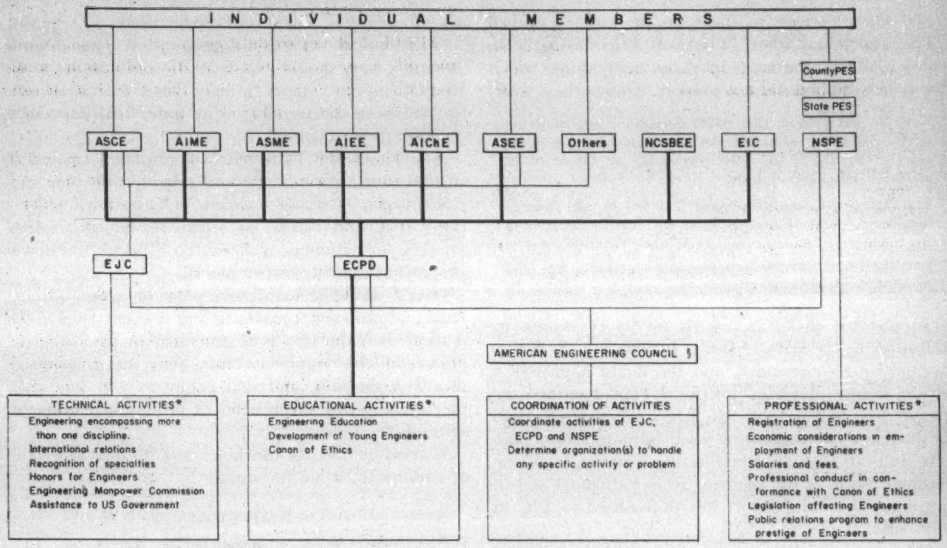
A. American Association of Electrical Engineers
B. Engineering Profession Society Paralleling Present Engineering Organizations
C. The Federated Engineering Societies
D. American Society of Engineers; a Single Society with Individual Membership for All American Engineers

A questionnaire developed to elicit membership opinion of the four plans was circulated at two General, five District, and 20 Section Meetings. Results of the survey were published in *Electrical Engineering*, April 1947, and conclusions drawn appeared in the May 1947 issue.

Replies indicated that 9 out of 10 AIEE members saw need for a change in organization of the profession, but that none of the proposed plans was acceptable without modification. Of the four, Plan D was first choice. The Subcommittee prepared a new plan based on Plan D, strengthened by incorporation of some features of Plans B and C. The new proposal called for an American Engineering Association with individual engineers comprising the membership, and with delegates elected on a proportional basis from two sources: (1) local units associated with state or regional societies and (2) national technical societies. This plan, which was described in *Electrical Engineering*, May 1947, was the one referred to EJC.

NOTE: Unfortunately, both AIEE and EJC designated their plans as A, B, C, and D. This has led to much confusion. From here on, in this article, plans referred to are EJC plans only.

In December 1950, EJC referred to the societies its four plans, already described under "Engineers Joint Council." While the majority preference among the societies was for Plan A, calling for EJC expansion, AIEE preferred Plan C, the "Merger Plan." In January 1952, the AIEE Board voted not to accept the Exploratory Group's recommendation that unity be developed through Plan A. However, in August, the Board reluctantly agreed to the recommendation, subject to pro-



* It is intended that any Constituent Society shall continue to perform any services it desires for its own members, including Students.

§ Name assigned for reference, subject to consideration; others are American Council of Engineering Societies, Joint Council of Engineering Societies. For proposed organization, see Memorandum of Intent, 1/13/59.

Fig. 9. Proposed Organization for the Engineering Profession (Functional Plan with a Co-ordinating Council).

portional representation, a condition which the other societies accepted. It was felt that a reasonable change of unity existed with Plan A as the initial step. It appeared necessary to reach a compromise of this nature, or start over.

AIEE representatives on EJC tried to convert EJC into an individual-membership organization, but obtained insufficient support.

In November 1953, President E. B. Robertson (1953-54) appointed an Exploratory Committee to consider whether the expansion of EJC could be considered successful, since its invitations to the eight other societies had resulted in the addition of approximately 21,300 members out of a possible 70,100. The Exploratory Committee's report was published in *Electrical Engineering*, April 1954, in a "Message on Unity from the President." AIEE's position was (as it still is) that a successful unity organization must have:

1. Individual Membership
2. Power and Ability to Act Promptly
3. Adequate Finances

Two other plans for a unity organization were proposed and published in *Electrical Engineering*, one by the General Electric Engineers Association (April 1953), the other by the late Walter B. Morton (October 1955).

The Functional Plan.

In June 1956, President M. D. Hooven (1955-56) convened the AIEE Board for an all-day session to discuss unity. The Board established principles, and appointed a Drafting Committee on Intersociety Relations to formulate a policy. After four drafts, the statement was completed, and was discussed at subsequent Board meetings. President M. S. Coover (1956-57) discussed the policy with other Society Presidents informally before it was published as a "Message from the President," *Electrical Engineering*, June 1957.

Briefly, the policy (later designated the Functional Plan) proposed that, for the present, AIEE lend moral and financial support to established societies, as follows:

Organization	*Engineering Profession's Medium for:*
AIEE	Advancement in technology in all branches of electrical engineering
EJC	Coordination on technological matters transcending the electrical field
	Public relations on technological matters
ECPD	Guidance in engineering education
	Accreditation of curricula
NSPE	Promotion of professional and economic status
	Public relations on professional matters

Publication of the Functional Plan evoked much interest and discussion. Unfortunately, there were also many misinterpretations, which President W. J. Barrett

(1957-58) undertook to clarify in his article entitled, "The Functional Plan," *Electrical Engineering*, February 1958. Mr. Barrett pointed out many things which the policy did and did not propose. Among these were:

1. It did **not** propose that AIEE discontinue any of its interests, give up any of its activities, or put an end to any of the types of services it has been performing on behalf of its members, including students.

2. It did **not**, of course, propose that any of the Founder Societies or Constituent Societies of EJC and ECPD give up any services they chose to perform for their members.

3. It **did** propose certain realignment of activities of EJC and ECPD, in both of which organizations AIEE is a member.

In response to EJC's request for its evaluation by Constituent Societies, AIEE's Intersociety Relations Committee recommended, and the Board approved, a report stating that the Functional Plan described the proper role of EJC, and that EJC's effectiveness could be increased by concerning itself with technical matters, and not with matters affecting economic and professional status of the engineer as an individual and in a group. This brief report was transmitted to EJC in July 1958.

With respect to the proposed consolidation of EJC and ECPD into an "American Engineering Association," the AIEE Intersociety Relations Committee prepared a report entitled "Position on Organization of the Engineering Profession," which was sent to EJC by President L. F. Hickernell (1958-59) in a letter dated November 20, 1958. The report, which was published in *Electrical Engineering*, February 1959, read in part, "There appears little to be gained and much to be lost by merging ECPD into an organization in which the seeds of incompatibility are inherent so long as a 'professional division' is considered." Also discussed was the undesirability of a merger from the standpoint of taxation.

In February 1959, the AIEE Board voted that EJC, ECPD, and their member societies be informed that AIEE does not favor, and finds unacceptable, the proposed merger of EJC and ECPD.

Also at its February meeting, the Board voted that a "co-ordinating body" composed of representatives from EJC, ECPD, and NSPE would not be inconsistent with the Functional Plan, provided it is not designed to be a directing or operating agency in itself. It would serve principally to insure the functioning of these three organizations in their respective fields of responsibility as contemplated by the Functional Plan, to avoid overlapping or duplication of interests, and to serve as the expression and symbol of unity in the profession.

Fig. 9 is an organization chart of the Functional Plan with such a co-ordinating council. This Plan currently is under consideration by representatives of the five Founder Societies and NSPE.

CONCLUSION

On one point, there is unity among engineers. That point is the need for unity. As to how this should be sought, there is widespread disagreement. To many, "Unity" means one over-all organization. Some believe the unity body should be a federation of existing societies. Others feel equally strongly that a federation cannot represent the engineer as an individual, especially on legislative matters.

The Functional Plan, with co-ordinating council if such is found desirable, would provide unity for specific purposes through existing organizations: federations (EJC and ECPD) on technical and educational matters; an individual-membership society (NSPE) on professional and legislative affairs.

Over a period of many years, plans have been formulated and proposed, considered and rejected. Sometimes it seems that the very heat generated by the intensive discussion and argument must weld the proponents into a single unit, and that engineers will find that they are enjoying the benefits of professional unity in spite of themselves.

Meanwhile, the trek continues, and the goal is certain of attainment, if not yet visible.

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28. Organization for Unity (Resolution of IRE Board of Directors, Mar. 27, 1953), *Proceedings* of IRE, Aug. 1953, p. 1067

29. Minutes, Board of Directors, National Society of Professional Engineers, Indianapolis, Ind., Nov. 7, 1953

Previous Lamme Medal Winners

1928 Allan Bertram Field	1943 A. H. Kehoe
1929 Rudolf E. Hellmund	1944 S. H. Mortensen
1930 William J. Foster	1945 David C. Prince
1931 Giuseppe Faccioli	1946 J. B. MacNeill
1932 Edward Weston	1947 A. M. MacCutcheon
1933 Lewis B. Stillwell	1948 V. K. Zworykin
1934 Henry E. Warren	1949 C. M. Laffoon
1935 Vannevar Bush	1950 Donald I. Bohn
1936 Frank Conrad	1951 Arthur E. Silver
1937 Robert E. Doherty	1952 I. F. Kinnard
1938 Marion A. Savage	1953 F. A. Cowan
1939 Norman W. Storer	1954 Aldo M. deBellis
1940 Comfort A. Adams	1955 Clinton R. Hanna
1941 Forrest E. Ricketts	1956 Harold H. Beverage
1942 Joseph Slepian	1957 Harold S. Black

(Article appears on pp. 819-26.)

Power Output and Derating Factor of Oil Well Motors

M. H. HALDERSON
MEMBER AIEE

ELECTRIC MOTORS that drive oil well pumping units are subjected to a continuously varying load characterized by high peaks and wide and rapid load variation. The exact load-vs-time relationship is influenced by many factors and is different for each installation. Load peaks may occur from 8 to 60 times per minute. Valleys between peaks are frequently negative where the motor momentarily acts as an induction generator and transfers energy from the pumping system to the electric power system. Ratio of peak load to average load ranges from 1.8 to 4.0.

Because of the type of load, motors that drive oil well pumping units must be derated in order to prevent thermal overload. What the operator needs to know is what per cent of rated power output a given type of motor can be expected to deliver without being thermally overloaded. This is found by measuring rms current and comparing motor output under actual pumping conditions with the power output on a steady load at the measured rms current. Derating factor, then, is defined as the ratio of average motor output on a pumping load to the output that the motor would develop on a steady load at the rms current measured on the pumping load. When measured rms current is near the full-load current rating of the motor, derating factor becomes the factor by which the motor power rating should be multiplied to give the average output that the motor can deliver on a pumping load without being thermally overloaded.

Obtaining derating factor as defined requires a determination of average power output under actual operating conditions. It cannot be measured directly, but it can be determined by a method that requires only taking measurements with relatively inexpensive instruments which can be used in the field by engineers or field testers. The procedure to use is as follows: (1) connect a watt-hour meter for measurement of the average power input to the motor; (2) connect a thermal ammeter to measure rms current; (3) from the performance curves of the motor, determine the output and efficiency on a steady load at the rms current measured on the test; (4) divide steady load output by efficiency to get the input to the motor on a steady load at the measured rms current; (5) subtract steady-load output from steady-load input to get motor losses; (6) subtract motor losses from measured power input to get actual average output on the test.

Derating factor is determined by dividing the average power output on the test by the output the motor would have developed on the steady load at measured rms current. If derating factor is to reflect the load-carrying capacity of motors driving pumping units, tests must be taken under conditions where the measured rms current is between 80 and 120% of rated current. A 5 to 8% slip Design D motor at half load will behave more like a loaded Design C motor, and derating factor will be too low.

The procedure outlined for obtaining derating factor is illustrated by a test where a 60-hp 440-volt 77-ampere 1,170-rpm high-torque normal-slip Design C motor was driving a pumping unit at 18.6 strokes per minute. From measurements made on the test, average motor power input equaled 49.4 hp and rms current equaled 84.7 amperes. On a steady load at 84.7 amperes, as obtained from the characteristic curves of the motor, output would have been 66.7 hp, efficiency 0.92, input 72.5 hp, and motor losses 72.5 minus 66.7 or 5.8 hp. Then, on the test, the average output equaled measured input minus losses equaled 49.4 minus 5.8 equaled 43.6 hp. Derating factor equaled average output on the test divided by output of motor on steady load at rms current measured on pumping load equaled 43.6/66.7 or 0.654.

One practical use of derating factors is to compare the performance of normal-slip Design C motors with that of 5 to 8% slip Design D motors when driving pumping units. A 60-hp 440-volt 1,125-rpm 71-ampere 5 to 8% slip Design D motor was installed in place of the 60-hp normal-slip motor for which data is given in the foregoing example. The rms current was 60.0 amperes and derating factor was 0.87. These two tests are typical of cases where a 5 to 8% slip motor is considerably underloaded when replacing an overloaded normal slip motor of the same rating.

Load variations were less severe than normal on the pumping installation used in the examples, which accounts for the derating factors being higher than average. Tests previously reported[1] showed average derating factors to be 0.58 for normal slip motors and 0.80 for 5 to 8 slip motors where rms currents ranged from 80 to 121% rated.

Although the discussion refers to motors that drive oil well pumping units, the procedures presented for obtaining average motor output and derating factor may be used in any application where a motor is subjected to a continous cyclic load.

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M. H. Halderson is with the Phillips Petroleum Company, Bartlesville, Okla.

Adjustable Speed Control of A-C Motors

L. R. FOOTE
ASSOCIATE MEMBER AIEE

Description of a drive that uses saturable reactors and a wound rotor motor to provide adjustable constant speed performance comparable to d-c variable voltage drives. A line contactor is used to connect the system to the power line. All regulating components are static. Motor currents are controlled in all three phases for motor heating.

THE DRIVE described in this article was developed specifically to meet the requirements of a hoist drive. Use will not be limited to hoists. A-c motor speed control has been achieved with essentially balanced primary voltage control. Control is effected through three saturable reactors, one of which has two power windings and is, therefore, a saturable transformer. Reactor excitation is controlled by magnetic amplifiers. Static regulating action provides forward or reverse phase sequence for driving or retarding torque as required to hold any desired speed. The rotor circuit consists of two sets of resistors and a closed iron nonregulated reactor. This provides a relatively uniform maximum torque at all speeds. Performance has been proved on a test tower as well as on a dynamometer.

This is believed to be an improvement on previous a-c motor adjustable speed drives. Only three primary reactors provide essentially balanced, static, reversing control of primary voltage. Novel use of a saturating transformer makes this possible. The transformer also compensates in part for reactor drop. The simple three-element control provides low cost and simple installation. Continuous speed adjustment through zero is provided to set down hoist loads with minimum shock.

ELECTRICAL DRIVE REQUIREMENTS FOR HOISTS

OBVIOUSLY, the basic drive requirement is to raise and lower a hook. Speed control is required to position accurately and to set a load down gently. Usually, the weight of load lifted should not vary the speed appreciably. The load should be smoothly accelerated from a suspended position so that a smooth hoisting action results when the holding brake releases. Drive must change speed smoothly without shock or speed overshoot. Automatic torque reversal may be required to break static friction and to accelerate an empty hook down.

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The author wishes to express appreciation of the assistance provided by his associates, P. L. Alger and P. A. Vance, in consulting, advising, and providing parts from which the test equipment was assembled.

In addition to these performance requirements, the type of construction is important. The control must be as static as possible to reduce maintenance. The number of wires between controller and trolley is limited by collector shoes. Equipment must resist vibration. Standard motors should be used.

SYSTEM SELECTION

A STANDARD a-c wound rotor motor drive is desirable for several reasons. Most important is that the commutator has been eliminated. An a-c motor costs less than a d-c motor. A d-c power supply is not required.

Saturable reactors provide static, stepless control of motor current. The reactors may be used to control motor primary or secondary current. Primary current control was selected so that phase reversal could be used. Phase reversal is required to obtain reverse torque below synchronous speed. The reactors control both the phase sequence of the applied voltage and the magnitude of the resulting current. This eliminates reversing contactors. The unique arrangement of saturable reactors provides better current balance than 2-phase control, full reversing torque, and maintains the simplicity and economy of only three saturable reactors.

The motor rotor external resistance must be changed with speed to obtain high torque at all speeds. To eliminate rotor circuit contactors a 3-phase reactor using a closed iron circuit and no control winding was used with two sets of resistors. The reactor inherently causes a low resistance circuit to predominate at high speed and the high resistance circuit to predominate at lower and plugging speeds.

The motor supplies both hoisting and braking torque so that the only accessory is a holding brake.

OPERATION

DEVICE NAMES in the following description correspond with the Fig. 1 schematic diagram.

The rotor circuit is designed to produce necessary torque at all speeds with full stator voltage. The resistors, *R1*, are selected to produce maximum torque around stall. Resistors *R2* have about 40% the ohms in *R1*. *R2* alone in the rotor circuit would provide good torque at high speeds but not about stall and at negative speeds. The closed iron reactor impedance makes *R2* predominant at high speeds and *R1* predominant at all other speeds. The motor plus rotor circuit thus requires only control of primary voltage phase rotation and magnitude for speed regulation.

As stated previously, three saturable reactors provide control of phase rotation and magnitude of the applied

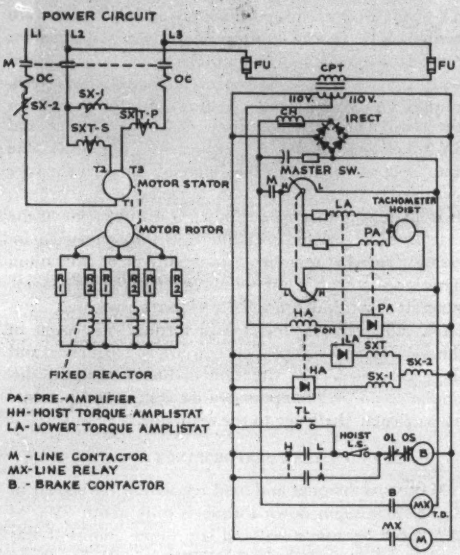

Fig. 1. Partial schematic.

motor voltage. These reactors are labeled *SX-1*, *SX-2* and *SXT*. In Fig. 1, *SXT* has two gate windings, *SXT-P* and *SXT-S*. This arrangement of saturable reactors is most clearly explained by building on more simple arrangements. Therefore, consider three separate saturable reactors as in Fig. 2A. It is obvious that if the direct-current control fields are not excited the only current in the motor will be the insignificant reactor magnetizing current. Fully exciting the saturable reactors will apply nearly full voltage to the motor. Intermediate values of d-c excitation permit adjustment of motor torque to any intermediate value.

Now consider that any two of the three saturable reactors in Fig. 2A are replaced with a single saturable reactor with two duplicate a-c power windings wound together. As before, the a-c power applied to the motor may be varied from almost zero to a maximum by the d-c current in the saturable reactors. Since the saturable reactor with the two windings is a transformer with zero d-c exciting power, the induced voltages across the two windings must be equal in magnitude and in phase opposition. Fig. 2B indicates the two winding reactor. Fig. 2C vectorially represents reactor voltages for connection shown in 2A. Fig. 2D shows how the vectors change when windings *A* and *B* are placed on a common core. Saturating the reactors with d-c excitation changes the vectors as shown in Figs. 2E and 2F.

If vectors *B* and *C* in Fig. 2D can be increased in length, the phase rotation at the motor will be reversed. Fig. 2G shows the motor side of reactor *C* connected to line *L2*. The phase reversal is shown in Fig. 2H. Vector *C* is full line voltage and so is vector *B*. The motor will run reverse. Refer now to the drive schematic, Fig. 1. Applying full d-c excitation to *SX-1* causes the a-c windings to have low impedance. This is similar to Fig. 2C. Saturating *SX-1* and *SX-2* produces voltage vectors per Fig. 2J. Thus, the voltage at the motor changes from Fig. 2H to Fig. 2J—from full-phase forward, to off, to full-phase reverse. Reactor exciting currents correspondingly change from *SX-1* and *SX-2* saturated for full forward, to no exciting current for full off to *SX-1* and *SXT* saturated for full reverse. Thus, full-forward to full-reverse torque control is obtained by regulating reactor exciting currents.

SX-1 is not connected quite on the end of *SXT-P* in the schematic diagram. By connecting to a tap rather than the end of *SXT-P*, autotransformer action compensates for the small saturated drop in *SX-1* and raises maximum torque.

Although the circuit is not symmetrical, there is reactor control of current in each of the three phases. The currents through each of the two power windings on *SXT*, and through *SX-2* are equal for balanced motor currents with *SXT* and *SX-2* saturated. With *SX-1* and *SX-2* saturated, *SX-1* current will be three times motor line current times the autotransformer ratio for balanced motor currents. Thus, *SX-1* current and *SXT* current are in fixed ratio to *SX-2* current. These relations inherently provide balanced phase currents, if the saturable reactors are proportionately excited. The reactors are designed to work together so that the same exciting current in *SX-2* and *SXT* or *SX-1* maintains essentially balanced load currents.

With the aforementioned basic concepts established,

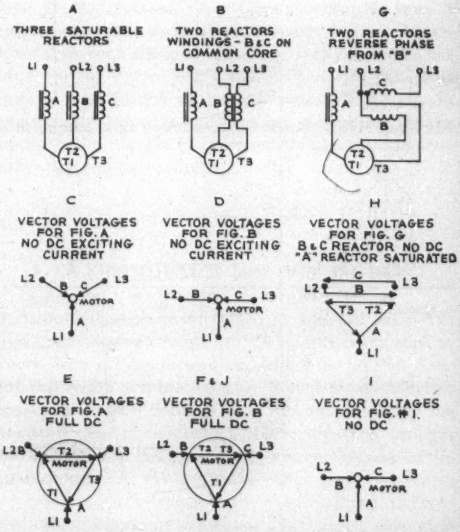
A
THREE SATURABLE REACTORS
B
TWO REACTORS WINDINGS - B & C ON COMMON CORE
G
TWO REACTORS REVERSE PHASE FROM "B"
C
VECTOR VOLTAGES FOR FIG. A NO DC EXCITING CURRENT
D
VECTOR VOLTAGES FOR FIG. B NO DC EXCITING CURRENT
H
VECTOR VOLTAGES FOR FIG. G B & C REACTOR NO DC "A" REACTOR SATURATED
E
VECTOR VOLTAGES FOR FIG. A FULL DC
F & J
VECTOR VOLTAGES FOR FIG. B FULL DC
I
VECTOR VOLTAGES FOR FIG. # I. NO DC
MOTOR

Fig. 2. Vector explanation of reversing action. These sketches are only explanatory and are not accurate in magnitude, direction, or balance.

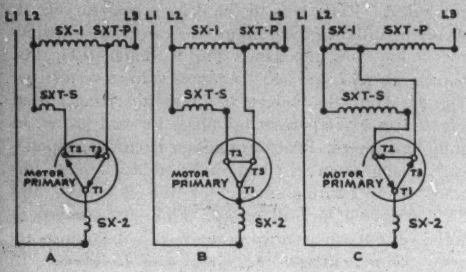

Fig. 3. The "why" and "how" of static reversing control. Pictorial length of reactor winding is proportional to impedance of winding.

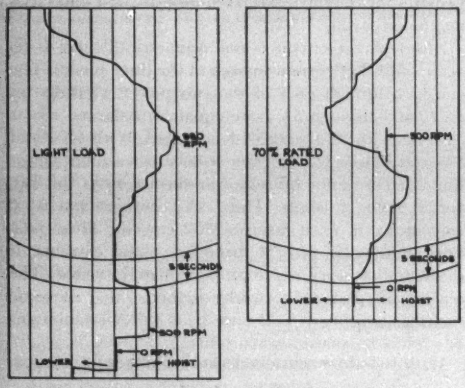

Fig. 4. Photoelectric recording of speed response on test tower.

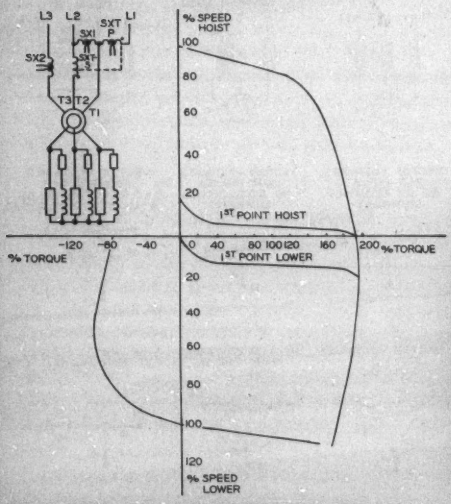

Fig. 5. Speed-torque curves for IC 7406 crane control.

SX-1 and *SX-2* are proportionately excited for forward torque. *SXT* and *SX-2* are proportionately excited for reverse torque. Speed regulation can be accomplished with any of many well-known servomechanism techniques. Power amplistats are shown and were used for the tests. The hoist amplistat, *HA*, excites *SX-1* and *SX-2*. Lower amplistat, *LA*, excites *SXT* and *SX-2*. The amplistats are excited by the difference between a master switch reference voltage and a tachometer feedback. It is interesting that the steady-state characteristic of the reactor drive produces an increasing torque with increasing speed at some fixed value of reactor excitation. This is similar to a rising speed regulation in a d-c motor generator loop which normally requires a very fast regulator. However, the increase in torque with speed in the a-c system is dependent on rotor frequency and therefore speed. The situation is, therefore, quite dissimilar to an over-compounded d-c system and presents no particular challenge to the regulator.

TEST PERFORMANCE

Maximum torques and load regulation are shown in Fig. 3. Maximum down torque is only about 75% at zero speed because a reduced size lower amplistat was used to produce down torque. With a full size lower amplistat, maximum torque in the down direction is only slightly less than in the up direction. The difference is due to the autotransformer compensating action.

Fig. 3A shows maximum torque-lowering. In this position, *SXT* and *SX-2* are saturated and, therefore, have very low impedance. This allows maximum flow of the a-c current from *L1* to *T1*, *L2* to *T2*, and *L3* to *T3*.

Fig. 3B shows zero torque. When *SXT*, *SX-1*, and *SX-2* are unsaturated, they present maximum impedance to the current flow in all three lines. This means that for all practical purposes, there would then be zero voltage at the motor terminals and motor torque would be zero.

Fig. 3C shows the maximum torque-hoisting position. In this position, *SX-1* and *SX-2* are saturated and present a very low impedance. Since *SX-1* and *SX-2* are

Fig. 6. Breadboard setup and test motor. Tower is visible through door.

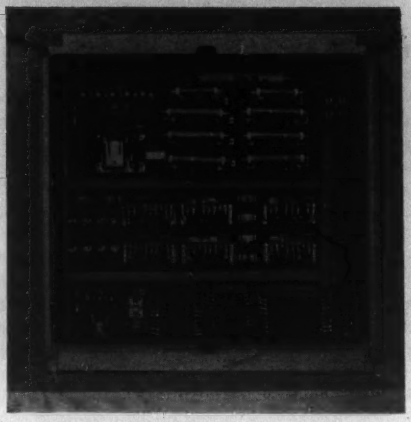

Fig. 7. Production version of hoist control.

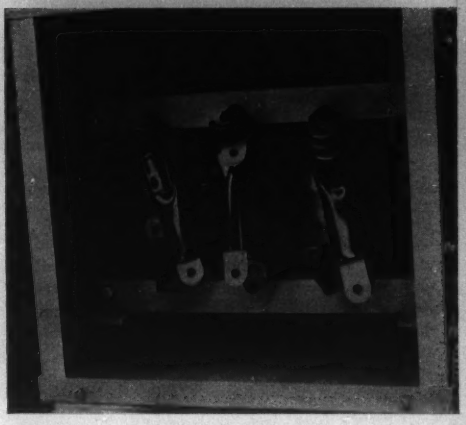

Fig. 9. Rotor circuit reactor showing taps for optimum adjustment.

effectively short circuits as a result of saturation, *L2* is connected to *T3* and *L1* is connected to *T1*. *SXT-P*, the transformer primary, has *L2-L3* voltage. Since *SXT-P* and *SXT-S* have a one to one turns ratio, *SXT-S* also has voltage equal to *L2-L3*. *T2* voltage becomes the same as *L3*. Notice that the voltage sequence *L1-L2-L3* is now applied to *T1-T3-T2*, compared with *T1-T2-T3* in the lowering position. This is a phase reversal and, therefore, gives a torque reversal.

Load regulation is better than required for hoist operation. The increase in load regulation for down torque is a function of the components used and is not basic. High gain is not necessary for down torque in normal hoist operation.

Safety requires that the minimum hoist speed be high enough so that 125% load will not lower the hook. Similarly, an empty hook must lower on the minimum lower speed. This creates a range of speeds between minimum hoist and minimum lower that has been traditionally unobtainable. Continuous speed adjustment between these points with a thumblatch on the master switch provides minimum landing speeds.

Response was rapid enough to permit smooth hoisting acceleration of loads suspended in air by a holding brake. Fig. 4 shows photoelectric tracings of speed vs time.

These tracings were taken on the test tower and show the response to step changes of the master switch. The test drive had more inertia than would be normally encountered because of safety brakes and oversize couplings on test gear. Zero speed was taken with a holding brake and suspended load. These data show that the load hoisted without dropping or hesitating from a suspended condition. It is also apparent that speed overshoot has been damped so torque oscillations do not occur in the gears. The response is not as fast as is usually experienced in the d-c system. However, in practice, the response has been fast enough to give the operator the illusion of increased torque over time acceleration resistance control.

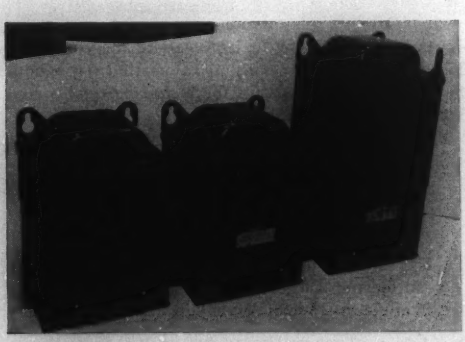

Fig. 8. Primary reactors SX-1, SX-2, SXT.

Communication via Rope

A special technique developed by The Colorado Fuel and Iron Corporation utilizes the wire hoisting rope to carry electrical conductors, embedded in the fiber cores for protection against damage. It makes possible zinc socketing of wire hoisting rope without damaging the enclosed electric conductors. These are then brought out through the basket of the socket and suitable terminal connections made. At the other end of the wire rope, where it is attached to the hoisting drum, the conductors terminate in slip rings. The electric current is picked off the slip rings by carbon brushes and then conveyed to transmitting and receiving equipment.

Automation in the Soviet Union

G. C. NEWTON, JR.
MEMBER AIEE

The Soviet Union invests 27% of its gross national product in new plants each year compared with our 19%. To maintain this higher rate of expansion, heavy emphasis is placed on automation. Observations of a delegation of automation specialists to the Soviet Union indicate this economic challenge must be taken seriously.

IN AUGUST 1958 a delegation of 13 automation specialists under the auspices of the American Automatic Control Council (AACC) departed for the Soviet Union on a 16-day tour of plants and research institutes with the purpose of studying Soviet automation. This delegation was in exchange for a visitation of a larger group of Russians to the United States at the time of the Automation Show in New York in June 1958. At the 1959 Winter General Meeting of the AIEE in New York, the Feedback Control Systems Committee sponsored a panel discussion by six of the AACC delegation members on their observations of Soviet automation. This article summarizes the conclusions of the panel speakers.

The meeting was opened by Harold Chestnut, chairman of the Feedback Control Systems Committee, who introduced the panel chairman, G. C. Newton, Jr. By way of introduction, the panel chairman explained that the AACC delegation was part of the Scientific and Cultural Exchange Program between the United States and the Soviet Union. An official delegation under this program usually has a host in the receiving country, and a sponsor in the sending country. Our official host in the Soviet Union was the State Scientific and Technical Committee under the Council of Ministers. Our sponsor, the AACC, represents five professional societies with interests in automatic control; namely, the AIEE, the Institute of Radio Engineers (IRE), the Instrument Society of America (ISA), the American Institute of Chemical Engineers (AIChE), and the American Society of Mechanical Engineers (ASME). These societies are represented in international affairs by the AACC.

The chairman cautioned the audience that the delegates were 2-week experts on Soviet automation and then introduced the panel members who gave prepared remarks on the following topics.

Report of a panel discussion held at the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959, on Soviet automation by six members of a delegation of automation experts who visited the Soviet Union in Aug. 1958. Recommended for publication by the AIEE Feedback Control Systems Committee.

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Organization of Research

E. J. KELLY, JR.

ON THE BASIS of visits to Moscow University, the Institute of Automatics and Telemechanics under the Academy of Sciences, a number of factories, and one industrial research institute, it appears the universities and technical institutes are primarily concerned with education. Research is carried on by organizations set up for very specific purposes. The Institute of Automatics and Telemechanics is an example of one of these. Here, we saw applied research projects relating to controls for the metallurgical and chemical processing industries, the electric power industry, as well as theoretical investigations on nonlinear controls, random processes, and information theory. In general, the research scientists and engineers select their own problems. The only educational function of the institute is the support of thesis research by men who have candidate status. Workers at the institute enjoy vacations of the order of 2 months in length and many are well enough off to possess summer homes (dachas) in the country as well as private automobiles.

Over-all guidance of the application of research results in industry is the function of the State Scientific and Technical Committee, our host. This committee of approximately 30 members (each with a staff) has the function of disseminating useful scientific and technical information to the industrial research institutes and factories throughout the USSR. It gathers information from the Academy of Sciences, the foreign literature, and individual factories and research institutes within the country. Its objective is to avoid technical blunders on a large scale, yet at the same time to encourage the widespread use of new innovations. According to Karibsky, chief expert on automation, the committee looks to increased emphasis on automation throughout Soviet industry as a means for increasing quality and volume of production.

Control Theory

R. J. KOCHENBURGER
MEMBER AIEE

ALTHOUGH no general evaluation of the Soviet automation effort is possible, the work that we observed at the Institute of Automatics and Telemechanics

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R. J. Kochenburger is with the University of Connecticut, Storrs, Conn.

appear to be of high quality. The journal published by this institute *(Automatica and Telemechanica)* enjoys a high reputation throughout the scientific and engineering world. The institute is housed in a rather small building for its 300 people but appears to have reasonably good facilities for carrying on its work. The apparatus made within the institute seems to be of very high quality and the instrumentation purchased outside the institute seems adequate with the possible exception of electronic instruments such as cathode-ray oscilloscopes. With respect to service personnel, there are enough good technicians but secretarial help appears to be in short supply.

The director of this institute, Prof. V. A. Trapeznikov, is an engineer whose main field of technical interest is electronic analog computers. He has been away on leave for some time and was represented during the delegation's visit by the acting director, Prof. A. M. Letov, known to engineers of this country already by the technical papers he has presented personally in the United States. Prof. Letov leans very strongly toward the more theoretical and mathematical aspects of feedback control systems and is especially interested in the dynamics of nonlinear systems.

The institute is divided into 11 departments, according to technical specialization. Two of the department heads, present at the meeting, conducted us on a tour of their laboratories. One of these was Prof. J. Tsypkin, who has a special interest in sampled and quantized data systems. He has written a number of technical papers in this area, including some in the English language, and is also the author of the book "The Theory of Relay Systems." On the question of analog-vs-digital computers as applied to control, Prof. Tsypkin was one of the few Russians present who seemed to place much faith in digital methods of control. Prof. Tsypkin's laboratory is devoted mostly to electrical control methods and includes analog simulators (such as the Russian *EMY-8A* developed at the institute) for the study of discontinuous control processes. For analog multiplication, they believe that the quarter-square method is the most suitable and claim accuracy for this method of the order of 0.5 per cent. Finite time delays are represented by delay lines—this method obviously works only with the "sped-up" time base type of analog computer used in conjunction with repetitive oscillograph displays of the response. Methods of introducing random disturbances are still under study.

The other department head who showed us his laboratory was Prof. M. A. Aizerman, also the author of a number of internationally known technical papers and of a basic textbook "Lectures on the Theory of Automatic Regulation." Prof. Aizerman's background is in the applied mechanics, rather than electrical, area. He has done considerable work in the field of self-adaptive process controllers and in the response of nonlinear systems. In his laboratory, he showed us some very compact wafer-shaped trigger and gating elements that operate on pneumatic principles without employing any moving parts. These are to be employed in the design of process control systems subjected to logical limits. He also showed some equally compact pneumatic versions of analog computing elements, based upon aerodynamic principles of operation and also without moving parts. These included adders, integrators, and square-root extractors, with orders of accuracy of one-half per cent. Prof. Aizerman admitted that his pneumatic devices did not have the response speeds of corresponding electric elements but argued that their ruggedness, insensitivity to vibration, thermal stability, and lack of fire hazard would offer distinct advantages when they were applied to the control of industrial processes.

Other engineers at the institute who participated in the discussions included: A. M. Petrovsky, now working on applications of information theory to control; V. S. Pugachev, on the analysis of systems subjected to random disturbances; A. A. Feldbaum (author of the book "Electrical Systems of Automatic Regulation") on adaptive and extremum controllers using electrical techniques; B. N. Naumov, on time-varying and nonlinear control methods; and A. B. Chelustkin, on specific process control applications. Mr. Chelustkin is now engaged in applying some of his theories to open hearth furnace control at the Metallurgical Combine at Tula.

The institute's function is described as the solution of basic problems in control but the work "basic" appears to apply to components, equipment, and applications as well as to theory. The institute's responsibility is research, not teaching and, hence, it has no direct connection with any institution of higher education. However, some members of its staff do have individual arrangements with teaching institutions and it does provide some facilities for thesis work associated with the obtaining of advanced degrees. Staff members seemed free to select their own problems and they reported little difficulty in obtaining funds.

Industrial Instrumentation and Control

NATHAN COHN
FELLOW AIEE

IN GENERAL, Soviet industry is dynamic and fast moving with the goal of overtaking and surpassing the United States. The reported growth figures in certain areas are impressive. For example, in steel the output has tripled in 10 years, and in the instrument industry the output has quadrupled in six years. The products of the instrument industry are, in general, of good quality although the designs are imitative of imported instruments. The Soviets are producing a wide variety of instruments including precision standards, secondary standards, deflection indicating instruments, and recording and controlling instruments for the process industries. We saw a number of instances where they

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had introduced innovations of their own beyond the conventional designs we are familiar with here.

We observed no chromatographic instrumentation, and there seem to be deficiencies in certain other classes of analytical instruments.

The Soviet production capability in the various instrument plants we visited appears to be very good and is apparently expanding. As an example, the Manometer plant in Moscow has a production line for the assembly of circular chart potentiometer recorders illustrated in Fig. 1. These recorders are similar to self-balancing recorders made in the United States. This assembly line is turning out about 100 units per 7-hour shift. It appears to be well organized, with subassembly feed lines, and with many checking points interspersed between groups of assembly stations. Within the knowledge of the delegation members, there is no corresponding assembly line for such instruments in use in the United States.

The delegation had several opportunities to observe the application of control instruments in industry. In steel and automobile manufacturing, relatively simple types of control for variables like temperature, pressure, humidity, and fuel-air ratio are frequently used. The theory of application of such controls is well understood by Soviet engineers. There was no evidence of complex control systems employing computers. Thus, the general conclusions seems to be that the Soviets are substantially on a par with us in simple control applications but behind us with respect to complex controls.

Machine Tools and Controls

W. E. VANNAH

AGAIN, the picture is one of remarkable growth. Up until 1918, practically all machine tools used in the Soviet Union were imported. Today USSR production of machine tools exceeds that of the United States in terms of number but, in terms of the production capacity of the machine tools made annually, the United States still leads.

W. E. Vannah is with the McGraw-Hill Publishing Company, New York, N. Y.

Fig. 1. Circular chart recorders on display at the Manometer Plant, Moscow, USSR.

One of the highlights of the delegation's visit was the tour of the Experimental Machine Tool Research Institute known as ENIMS in Moscow. Although the building is run down and poorly maintained, there is much good equipment crowded into its factory and laboratory areas. The function of this institute is to improve machine tools and production processes using machine tools. Approximately one third of the staff of this large research institute is devoted to control problems.

The delegation saw evidence of research on the control of individual machine tools as well as on groups of tools with associated transfer mechanisms. At the All Union Agricultural and Industrial Exposition in Moscow, there is a horizontal boring machine with a numerical control system. A photograph of this equipment is shown in Fig. 2. This tool and its associated controls were developed at ENIMS where, at present, there is a continuing effort on the development of numerical controls for their machine tools. Also, at ENIMS the delegation observed a Detroit-type of automated production line that machines shafts for induction-motor rotors, assembles the shafts to the rotors, and then automatically balances the completed assemblies. This development is indicative of the emphasis that is being placed on automation in the manufacture of electric motors.

The general conclusion to be drawn from our observations appears to be that machine tool control lags the United States and the United Kingdom. However, the Soviets are emphasizing research and development work on machine tool controls and it is to be expected that the lag may be diminished when they decide on the kinds of control which they should standardize on.

Economics and Incentive Plans

S. W. HERWALD
MEMBER AIEE

THE TRIP had a sobering effect on all members of the delegation. Before World War II, the Soviets were behind us in all things. They are now ahead of us in certain things although on the basis of a composite average they are still behind us. They have copied many of the good parts of our private-enterprise system. Industry is now being decentralized and appears to be in the hands of competent management.

The central planning of production for the whole Soviet Union is the function of the agency known as the Gosplan. Plans are mapped out in a general way for 7 years in advance and in detail for 1 year in advance. The management of a factory faces a simpler set of problems than in the United States. Its function is to produce the assigned quota (or more) at the factory cost

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Fig. 2. ENIMS' numerically controlled machine tool on display at the All-Union Agricultural and Industrial Exposition, Moscow, USSR.

agreed upon. There is no need to worry about inventories or sales as these functions are handled by the trading ministries and Gosplan. Production of certain items is centralized in fewer factories than in the United States. Examples are the Moscow watch factory where wrist watches are produced at the rate of 33 million units a year, and the First State Ball Bearing Plant (Moscow) which produces approximately 50 million ball bearings a year.

Incentive systems are used to encourage new ideas and to increase productivity. Factories generally have review committees for making awards for suggestions and innovations. From 5,000 to 10,000 rubles are commonly paid for ordinary suggestions. From 50,000 to 500,000 rubles are paid for significant ideas and inventions. (The tourist's rate of exchange is 10 rubles to the dollar.) In addition to awards paid to individuals, there are bonuses paid to all workers when the production goal of a factory has been met for a particular month. These bonuses range from the order of 20 per cent for workers to the order of 40 per cent for managers and engineers. Factory prices are adjusted to permit a factory to show a profit. In event that a factory is able to produce at less than the assigned cost, 40 per cent of the extra profit goes to the plant's account. These funds are used for plant expansion, awards, etc. In addition to these resources, the factory can borrow from the state bank for financing new machinery or new buildings.

CONCLUSION

DURING THE YEAR 1957, the gross national product of the Soviet Union was estimated to be $140 billion which compares with that of the United States of $440 billion. It is estimated that 27 per cent of this gross national product went into investment in new plants, facilities, housing, and so forth in the Soviet Union. This is in contrast to the United States where 19 per cent of the gross national product went into investment. With this larger rate of investment, the Soviet Union should be able to expand its economy at a higher rate relative to its present size than we are expanding ours. By continuing a higher rate of expansion long enough, the leaders of the Soviet Union hope to overtake and surpass the United States in industrial output. The situation indicated by the investment figures for the Soviet Union seems to be confirmed by the emphasis which they place on automation. They are looking to automation as a way of improving both their rate of production and the quality of their products. The observations of this delegation indicate that we should not be complacent about the economic challenge offered by the Soviet Union.

"Where do we go from here?"—was a question raised during the discussion following the prepared remarks of the panelists. All panel members agreed with Mr. Cohn who replied that extremes should be avoided in appraising the comparative effectiveness of Soviet instrumentation and control technology. We should heed the warning of Senator Saltonstall and not succumb to the "Sputnik syndrome" which assumes that all Soviet technological effort is superior to our own. Nor should we embrace the concept that everything we do is better than the USSR effort. The truth is somewhere in between. There is a lesson we should strive to follow in a legend associated with a children's fountain at Peter's Summer Palace (Petrodvorets) outside of Leningrad, visited by the delegation. Figures representing several ducks, and a dog who is pursuing them, are fixed to the rim of the wheel turned by the water jets of this particular fountain. Referring to the dog who is pursuing them, the ducks say, "Though he is strong enough to chase us, he is not fast enough to catch us."

Automated Banking

Arrangements were concluded recently between The First National City Bank of New York and International Telephone & Telegraph Corporation to proceed with the installation of an automatic system to process bank checks, perform deposit accounting, and related reporting and analysis functions.

Scheduled to go into operation early in 1961 in the new uptown headquarters of First National City at 399 Park Avenue, New York, N.Y., the system will permit rapid electronic and mechanical processing of all checks and documents regardless of type, shape, or size. Information on an account may be provided in seconds.

A unique feature will be the use of a reusable Mylar jacket to transport items through the system. Data concerning contents will be coded on a strip of magnetic tape affixed to the jacket to permit rapid processing regardless of the condition of the document.

The system has been designed to conform to the bank's operations and procedures and consequently little change in methods will be needed.

INSTITUTE ACTIVITIES

Middle Eastern District Meeting Presents Program of 30 Technical Sessions

THE AIEE Middle Eastern District Meeting, held May 19-21, 1959, in the Lord Baltimore Hotel, Baltimore, Md., was attended by 636 members and guests.

Some 30 technical sessions were on the program, covering computers and automatic programming, industrial equipment and controls, measurements and testing, power transmission and distribution, switchgear, education, management, etc. In addition, six inspection trips were offered to several manufacturing companies and testing facilities in the vicinity.

The social activities included a smoker on Tuesday evening and a dinner-dance the following evening. On Wednesday, the ladies enjoyed an all-day trip to the U.S. Naval Academy in Annapolis, Md., where they witnessed a full-dress parade of the Midshipmen Brigade, after a sight-seeing tour of the city.

General Session

The meeting started with the general session on Tuesday morning. Dr. P. L. Betz, general chairman, presided and welcomed the members to the meeting and to Baltimore. He introduced T. W. Trice, chairman of the general session, who in turn introduced Dr. B. R. Teare, vice-president of the Middle Eastern District and dean of engineering and science, Carnegie Institute of Technology. Dr. Teare said that ever since its beginning, AIEE had been the medium whereby engineers become communicative. He commended the students who had presented excellent papers at the District student paper contest and deplored the fact that the student membership is not growing as it should.

Mr. Trice then introduced AIEE President L. F. Hickernell, who spoke about the "Institute's Birthday" (see page 806).

The guest speaker was the Very Reverend V. F. Beatty, S.J., president of Loyola College, Baltimore. He discussed the fact that engineers and physicians today have a certain prestige—they have appeared numerous times on television broadcasts talking about their work with the result that people look up to them because of their education. People look to the engineer for solutions to human, professional, and social problems, because of the responsibilities which he has acquired.

"We are getting into slip-shod ways in the world today," Father Beatty continued. "We are too prone to protest among ourselves about the high prices we have to pay for almost everything and about the low prices of imported goods. It should be remembered that it is not solely low labor costs that price some foreign-made articles below similarly made American goods; many foreigners have high ideals pertaining to social betterment and set a high value on good workmanship."

Father Beatty concluded that the engineer has responsibilities that he cannot shirk. Together with all kinds of people, he must assist in solving the problems of people both here and abroad.

Lunar Orbit Model

On exhibit in the lobby of the Lord Baltimore Hotel was a working model showing satellite paths about the earth and the moon. On loan from The Martin Company, the pinball-like model consisted of a ball rolling on a surface which curved downward as it neared the positions of the earth and moon, depicting the pull of gravity. On the control panel, a "guidance" lever set the angle of launch and a "thrust" lever adjusted the velocity of the ball. When the "fire" button was pushed, a steel ball (the satellite) rolled toward the moon from the vicinity of the earth and the player tried to make the necessary adjustments so that the ball would go around the moon and the earth in a figure 8 orbit. This exhibit was popular with the members who tried to make a successful launch.

COL. ALFRED ASCH, USAF, plays with The Martin Company's earth satellite "pinball game" on exhibit in the lobby of the Lord Baltimore Hotel during the Middle Eastern District Meeting of the Institute, May 19-21, 1959.

Technical Sessions

Satellite Tracking. One of the most interesting sessions was that devoted to satellite tracking. In an introductory paper, "Low Signal Level Missile Instrumentation," L. G. deBey, Ballistic Research Laboratories, explained some of the general problems which arise in connection with gathering data from the satellites which are in orbit.

V. W. Richard, Aberdeen Proving Ground, described the Doploc tracking filter. Its primary function is to provide large improvements in the signal-to-noise ratio of noisy Doppler signals by the reduction of bandwith. A unique feature of the filter is the use of a third-order servo control system which makes it possible to maintain lock-on to the signal under dynamic flight conditions, thus obtaining maximum signal-to-noise improvement by allowing the use of the narrowest of possible bandwidths.

A long-range tracking and telemetry system called Microlock was described by W. F. Sampson, Hallamore Electronics Co. The phase-lock loop is used as a convenient mechanization of near optimum correlation detection, which is a process wherein a local estimate of the transmitted signal is generated in the receiver utilizing all available information describing the characteristic of the probable transmitted signal. The local estimate is compared with the noisy incoming signal in such a way as to indicate, over a long-time average, the nature of the incoming signal. The phase-lock loop is an electronic servomechanism which continuously adjusts the local estimate to maintain the indicated average error near zero.

Engineering Management. In one of the two sessions devoted to management, J. J. Durkin, General Electric Company, discussed productive maintenance. With today's increased production combined with labor, materials, and equipment costs, a scheduled maintenance program is necessary. His company has already applied electronic computers to simplify scheduling for maintenance emergencies which occur in production lines. All emergency

LEFT: T. W. Trice was general session chairman for the AIEE Middle Eastern District Meeting, held May 19-21, 1959, in the Lord Baltimore Hotel, Baltimore, Md. *Right:* Guest speaker at the general session was the Very Reverend V. J. Beatty, S. J., president of Loyola College, who discussed the responsibilities of the engineer in present day society.

shutdowns cannot be eliminated, but productive maintenance will reduce to a great extent such situations.

C. F. Savage, General Electric Company, presented "Peripheral Professional Problems of a Manager of Engineering." The primary effort of an engineering manager is to draw on the profession of management to lead his organization in the best discharge of their duties. To illustrate his point, the speaker showed a circular chart in which concentric circles listed the characteristics which a good manager should exhibit and practice in his proper functioning.

Television. Two of the papers in this session were of particular interest. The first was by W. L. Braun, Shenandoah Broadcasting, Inc., entitled, "Experience with Long Distance Television Fields Used for Retransmission." This paper dealt with the experiments conducted in the selection of a site for antennas for receiving and retransmitting television signals. In the course of the investigations over several years, it was found that ideas of siting had to be abandoned and new concepts found.

The second paper, which was widely discussed, was by F. J. Beste, Jr., and W. F. Jacob, Jr., Maryland Tele-communications, Inc., entitled, "Video Instruction Techniques." This was a description of a method of using closed-circuit television on a production line in the manufacture of electronic chassis. At the instructor's station, a camera with a special tube picked up and transmitted all the instructor's motions, i.e. placing the components, dressing the connections, the terminals to which they were soldered, etc. At the same time, the instructor described over a microphone, the part which was being installed. Seated before a series of monitors with identical chassis before them were a number of operators who followed the visual and aural instructions (through small earphones) of the instructor. It has been found that this type of instruction has increased the operators' speed and accuracy in assembling the components on a chassis.

Engineering Education. One of the most thought-provoking sessions of the meeting was that devoted to the education of engineers.

The first paper, by T. M. Linville, General Electric Company, concerned the role

DR. P. L. BETZ, chairman of the Middle Eastern District Meeting, with speakers and committee chairmen at the Tuesday morning general session which opened the District meeting. Dr. Betz, the presiding officer, welcomed the members to the meeting and to the city of Baltimore.

DISCUSSING Institute affairs at the Middle Eastern District Meeting are (*left to right*): P. L. Betz, general chairman; L. F. Hickernell, president of AIEE; and B. R. Teare, Jr., AIEE vice-president for the Middle Eastern District.

AIEE is playing in the training of young electrical engineers in colleges, and what the AIEE Education Committee proposes to do in the near future.

G. A. Richardson, Worcester Polytechnic Institute, presented "Education for Exploding Challenges in Electronics." After discussing the various new developments in the field of electronics, the speaker explained the problems of many faculties in determining just what a student should be taught so that he will be prepared to take his place in this "exploding" field. It is not enough to train students in today's technology and science. Curricula must provide an understanding of the fundamentals of electrical behavior which can serve as a stepping-stone to the understanding of new developments which are sure to come.

R. L. McFarlan, a consultant, spoke on the role that the Institute of Radio Engineers (IRE) plays in electrical engineering education. He explained the educational work done by the society's committees and how they are co-operating with colleges. He made a plea for more mathematics to be given in schools and for more courses on the humanities.

The final paper of the session was written by G. S. Brown, Massachusetts Institute of Technology, and in his absence was read by Dr. Ferdinand Hamburger, Johns Hopkins University. Its subject was "Education for Expanding Horizons in Electric Power." Industry needs to keep abreast of the changing technical content of modern engineering curricula and of the changing educational environment in order to communicate with tomorrow's graduates. It needs to appreciate the role of on-campus research and graduate study in keeping our educational institutions places of learning, rather than merely places for teaching. The importance of aiding practicing engineers to obtain refresher instruction in an organized manner every 5 years or so is increasing. The key to the much-needed communications between leaders in the power industry and engineering professors is to initiate more open-ended programs of on-campus research under direct industry sponsorship.

In the discussion period, W. J. Mayo-Wells compared European and American educational methods. He believes too much emphasis is placed on mathematics in our schools and that students are not taught to think.

Mr. Richardson stated that mathematics should be put into its proper perspective so that we can have models. Mr. McFarlan said that mathematics are an important phase of engineering for many of the modern miracles are the result of mathematical flights of the imagination.

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Electrical Engineering

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(Contents—Printed Matter) **Printed in U. S. A.**

U. S. Engineering Students Train in Europe this Summer

Nearly 100 engineering and science students from 39 colleges and universities in the United States are spending from 8 to 12 weeks in on-the-job training programs in foreign industry this Summer. At the same time, 70 students from foreign countries are working in 50 companies in this country. Announcement of this international exchange program for 1959 was made recently by Engineers Joint Council (EJC), sponsors of the United States Committee for the International Association for the Exchange of Students for Technical Experience (IAESTE), which administers the United States portion of the program.

The students from American colleges and engineering schools are training in 14 European countries, including Austria, Denmark, Finland, France, Germany, Great Britain, Israel, Italy, the Netherlands, Norway Spain, Sweden, Switzerland, and Turkey. Mechanical engineering students are the largest segment of the group, with chemical and electrical engineers next, followed by students in chemistry, physics, and architecture.

Some 60 students left on Saturday, June 20, on a chartered KLM Royal Dutch Airliner. The others planned to make the trip individually at other times.

IAESTE is an international, nongovernmental, nonprofit organization founded at London University's Imperial College in 1948 for the purpose of providing on-the-job training in foreign industry for student engineers and scientists. Its initial 10 Western European member countries began the program in 1948 with an exchange of 920 students. At the close of 1958, a total of 39,996 students had been exchanged in this international program between its 26 member countries. Policy for IAESTE stems from its Annual Conference of representatives of member nations, with operational responsibilities resting with each country's own Committee. Josef Wischeidt, Jr., is the executive secretary of the U.S. IAESTE Committee.

The Association is closely allied with EJC's Committee on International Relations.

In the operation of the program itself, advanced university students use the facilities of the U.S. IAESTE Committee (now at EJC, 29 W. 39th St., New York 18, N.Y.) to arrange for training in the industrial techniques of another country. At the same time, foreign students come to the United States for a training experience with American industry. The program is reciprocal, and the number of American students who can train in a foreign country depends upon the number of foreign IAESTE students who will train in the United States. Participating United States companies pay a nominal fee to cover administration costs. Each American student interested in a training experience abroad is charged a nominal registration fee. Students also pay their own travel expenses to the country of their choice. Once there, however, they earn a maintenance allowance which covers living expenses during the training period.

AIEE Future Meetings

Petroleum Industry Conference*
Wilton Hotel
Long Beach, Calif.
August 23-26, 1959

AIEE-ASME Engineering Management Conference*
Statler Hotel
Los Angeles, Calif.
September 16-18, 1959

Nonlinear Magnetics and Magnetic Amplifiers Conference (Exhibits)*
Shoreham Hotel
Washington, D. C.
September 23-25, 1959

AIEE-ASME National Power Conference*
Muehlebach Hotel
Kansas City, Mo.
September 27-October 1, 1959

AIEE-IRE Industrial Electronics Conference*
Mellon Institute
Pittsburgh, Pa.
September 30-October 1, 1959

Fall General Meeting
Morrison Hotel
Chicago, Ill.
October 11-16, 1959
(Final date for †TP—closed, ‡CP Syn.—closed, CPMs—Aug. 7)

National Electronics Conference
Sherman Hotel
Chicago, Ill.
October 12-14, 1959
(Final date for †TP—closed, ‡CP Syn.—closed, CPMs—Aug. 7)

Fall Textile Conference
Hotel Charlotte
Charlotte, N. C.
October 15-16, 1959
(Final date for †TP—closed, ‡CP Syn.—closed,—CPMs—Aug. 11)

Machine Tool Conference
Hotel Cleveland
Cleveland, Ohio
October 19-21, 1959
(Final date for †TP—closed, ‡CP Syn.—Aug. 4. CPMs—Aug. 14)

AIEE-IRE-ISA National Automatic Control Conference
Sheraton Hotel
Dallas, Tex.
November 4-6, 1959

Control Systems Components Conference
Dallas, Tex.
November 5-6, 1959
(Final date for †TP—Aug. 7, ‡CP Syn.—Aug. 21, CPMs—Sept. 1)

AIEE-IRE-ISA Electrical Techniques in Medicine and Biology Conference (Exhibits)
Sheraton Hotel
Philadelphia, Pa.
November 10-12, 1959
(Final date for †TP—Aug. 12, ‡CP Syn.—Aug. 28, CPMs—Sept. 7)

Appliance Technical Conference
Biltmore Hotel
Los Angeles, Calif.
November 16, 1959
(Final date for †TP—Aug. 18, ‡CP Syn.—Sept. 1, CPMs—Sept. 11)

Magnetism and Magnetic Materials Conference
Sheraton Cadillac Hotel
Detroit, Mich.
November 16-19, 1959
(Final date for †TP—Aug. 18, ‡CP Syn.—Sept. 1, CPMs—Sept. 11)

AIEE-IRE-ACM Eastern Joint Computer Conference
Statler Hilton Hotel
Boston, Mass.
December 1-3, 1959
(Abstracts and Summaries—Aug. 15)

AIEE-NEMA Second National Conference on Application of Electrical Insulation
Shoreham Hotel
Washington, D. C.
December 8-10, 1959
(Final date for †TP—Sept. 9, ‡CP Syn.—Sept. 25, CPMS—October 5)

AIEE-IRE-ASQC Symposium on Reliability and Quality Control
Hotel Statler
Washington, D. C.
January 11-13, 1960
(Abstracts—closed, final papers—Oct. 15)

Winter General Meeting
Hotel Statler
New York, N. Y.
January 31-February 5, 1960
(Final date for †TP—Nov. 12, ‡CP Syn.—Nov. 17, CPMs—Nov. 27)

AIEE-IRE-U of P Transistor and Solid-State Circuits Conference
University of Pennsylvania
Philadelphia, Pa.
February 11-12, 1960.
(Final date for †TP—Nov. 12, ‡CP Syn.—Nov. 27, CPMs—Dec. 8)

EJC Nuclear Congress
New York, N. Y.
April 3-8, 1960

Southwest District Meeting
Shamrock-Hilton Hotel
Houston, Tex.
April 4-6, 1960
(Final date for †TP—Jan. 4, DPMs—Jan. 29)

East Central District Meeting
Daniel Boone Hotel
Charleston, W. Va.
April 12-14, 1960
(Final date for †TP—Jan. 13, DPMs—Feb. 5)

AIEE-ASME-IRE Automatic Techniques Conference
Sheraton-Cleveland Hotel
Cleveland, Ohio
April 18-19, 1960
(Final date for †TP—Jan. 19, ‡CP Syn.—Feb. 2, CPMs—Feb. 12)

Great Lakes District Meeting
Hotel Pfister
Milwaukee, Wis.
April 27-29, 1960
(Final date for †TP—Jan. 28, DPMs—Feb. 22)

North Eastern District Meeting
Sheraton Biltmore Hotel
Providence, R. I.
May 2-4, 1960
(Final date for †TP—Feb. 2, DPMs—Feb. 26)

AIEE-IRE-ACM Western Joint Computer Conference
Fairmont Hotel
San Francisco, Calif.
May 3-5, 1960
(Final date for †TP—Feb. 3, ‡CP Syn.—Feb. 19, CPMs—Feb. 29)

AIEE-IRE-EIA-WCEMA Electronic Components Conference
Washington, D. C.
May 10-12, 1960
(Final date for †TP—Feb. 10, ‡CP Syn.—Feb. 26, CPMs—March 7)

Farm Electrification Conference
Sheraton-Fontenell Hotel
Omaha, Nebr.
May 10-12, 1960
(Final date for †TP—Feb. 10, ‡CP Syn.—Feb. 26, CPMs—March 7)

*Final date for submitting papers—closed

†TP—Transactions Paper
‡CP Syn.—Conference Synopsis
CPMs—Conference Manscript
DPMs—District Manuscript
(District Paper Synopses should be directed to the District Meeting Committee)

Transactions and conference papers must conform to the requirements in *Authors Guide*
For a copy, write to E. C. Day AIEE, 33 W. 39th St., New York, N. Y.

Manuscript Guide for the Author of a Transactions Paper

1. *Author's Guide.* Each prospective author should obtain a copy of the 1957 "Author's Guide" from the Assistant Secretary for Technical Papers, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y., before proceeding with the preparation of a paper.

2. *Transactions Papers.* Formally reviewed technical papers, judged on the basis of permanent reference value, for publication in the Institute's official *Transactions.*

3. *Manuscript of Paper.* Should be typed on one side only of 8½- by 11-inch white paper. Use new black typewriter ribbon and clean type. Erasures are unacceptable on original copy.

Copies required: Original plus three reproductions.
Spacing: Single-spaced text, double-spaced between paragraphs.
Title: CAPITALS, underlined, centered at top of page.
Section headings: CAPITALS, centered.
Margins: ½ inch at top and sides, and 1 inch at bottom.
Page numbers: Centered in top margin.

4. *Equations.* Those that cannot be typed should be in black ink.

5. *Figures and Illustrations.* Copies required: Original tracings plus three prints. All drawings, curves, etc., must be drawn in black india ink on tracing cloth or on good quality tracing paper.

6. *Blueprints.* Acceptable for copies only and not as originals.

7. *Lettering.* On all drawings, lettering should be large enough so that, when reduced in size in printing, the letters will not be less than 1/16-inch high.

8. *Captions of Figures.* Captions are never reproduced from the lettered drawings. They should be typed on a separate page, each one in a block 3¼ inches wide, and separated by at least 2 spaces. These are cut out and placed in an appropriate place with the figure when the manuscript is reproduced.

9. *Due Date for Manuscripts.* Usually, the manuscript is due 90 days prior to meeting where it is to be presented. For official closing dates, see the Institute Activities Section of the latest issue of *Electrical Engineering.*

10. *Send Copies to:* E. C. Day, Assistant Secretary for Technical Papers, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

11. *Review.* Papers are reviewed by the cognizant Technical Committee(s). Papers must meet Institute requirements as described herein.

12. *Presentation.* All Transactions papers must be presented at a regular General or District Meeting, or Special Technical Conference. When author submits paper, he should indicate meeting at which he wants it presented.

13. *Preprinting.* Prior to the meeting at which they are presented, accepted papers are preprinted by the Institute for distribution, at cost, to interested persons.

14. *Discussions.* If a written discussion of a Transactions paper is to be published with the paper, it must be submitted (three copies, double-spaced) to Mr. Day within two weeks after the meeting. This discussion need not have been presented at the meeting.

15. *Author's Closure.* Authors are usually asked to reply in writing (closure) to written discussions of their papers.

16. *Publication.* After presentation, the complete manuscript, together with written discussions and author's closure, is published in *Transactions.*

17. *Digests.* Digests of 1,000 words (less 250 words for each figure) are required from the author for publication in *Electrical Engineering,* so that the membership-at-large may be apprised of at least the substance of all TP's. They should be submitted to Mr. Day with the manuscript.

Manuscript Guide for the Author of a Conference Paper

18. *Conference Papers.* Papers scheduled for a General Meeting or Special Technical Conference that were not offered for formal review; or, if reviewed, were not judged to have permanent reference value.

19. *Presentation.* A brief abstract or outline of the paper must be submitted for approval of the chairman of the sponsoring committee, 80 days or more before the meeting.

20. *Scheduling.* Scheduling the paper is at the sponsoring committee chairman's discretion. Conference papers on a certain subject may be solicited by him.

21. *Complete Manuscript.* Not required before the meeting, but if the author submits his paper *at least 65 days before the meeting,* in the same form as that required for Transactions papers, the Institute will reproduce it for preprint distribution. Copies required: original and one duplicate.

22. *Distribution.* Distribution of conference papers by the author is permitted, provided at least 50 copies of his paper are furnished to the Institute to supply other requests.

A chart listing requirements for authors and publication rights for AIEE papers and articles will be found on the following page.

Requirements for Authors and Publication Rights for AIEE Papers and Articles

Paper Type	Preparation	Submission*	Review	Property of	Republishing
1. Transactions	Formal—single-spaced typing in accordance with p. 8, "Author's Guide"	Minimum of 90 days prior to presentation unless waived by Executive Committee	TOD	Institute	After presentation, by release from Publications Department of Institute giving full credit to AIEE
2. One-page Digest of Transactions Paper	Formal—double-spaced in accordance with p. 8, "Author's Guide"	To TOD when paper is submitted	TOD	Institute	ditto
3. Discussion	Formal—double-spaced typing in according with p. 8, "Author's Guide"	Within 2 weeks after presentation	Author of Transactions Paper	Institute	ditto
4. Conference (including District papers) (No preprint or own preprint)	Author's option	Abstract 2 weeks prior to day of presentation	Option of Technical Committee (Usually require an abstract only) (See: Submission)	Author	Institute name not mentioned. After presentation and provided it is not to be published by AIEE
5. Conference (Preprints by Institute)	Formal—single spaced typing in accordance with p. 8, "Author's Guide"	Prior to submission date listed for that conference in the appropriate issue of *Electrical Engineering*	ditto	Author	ditto
6. Articles for *Electrical Engineering*	Formal—double-spaced typing in accordance with p. 8, "Author's Guide"	To Editor as early as possible	Publications Department	Institute	After publication, by release from Publications Department of institute, giving full credit to AIEE

*General information on papers may be obtained from Assistant Secretary for Technical Papers.

General Restrictions on all Papers

1. Paper must not be released for outside publication prior to presentation.
2. No person shall receive monetary compensation from the reprinting of any paper or discussion presented before the Institute without previous authorization from the Board of Directors.
3. All rights are held by AIEE on preprinted Conference papers for two weeks after the end of a meeting.

Prominent AIEE Members Speak at Ground-Breaking Ceremonies for Project EHV

ON MAY 27, near Pittsfield, Mass., a group of consulting engineers, Berkshire County officials, and representatives of co-operating companies witnessed the ground-breaking ceremonies for the first tower of General Electric Company's Extra-High-Voltage Experimental Line known as "Project EHV" (*Electrical Engineering* August 1958, pp. 669-74). AIEE President-elect, J. H. Foote (F '32), chief engineer of Commonwealth Associates, Inc., and Chairman L. R. Gaty (F '50) of the Edison Electric Institute (EEI) Task Force on Extra-High-Voltage Transmission, emphasized the importance of the project. Their remarks follow.

Remarks of J. H. Foote
AIEE President, 1959-60

"The transmission of power over high-voltage lines has intrigued engineers for three generations. Many pioneering advancements have been accomplished since

Fabian Bachrach

J. H. Foote

the triumphs of the 1890's when pin-type insulators—delicate mechanically and poorly balanced electrically—supported conductors carrying as much as 40,000 volts.

"Experimentations were then carried on in what today would seem to be a most elementary fashion. Those of us who lived in the atmosphere and shared in the uncertainties of those years can appreciate the courage required of the engineer–entrepreneur who undertook to push transmission voltages up to untried levels of operation.

"Now, it happens that my father, J. B. Foote, was one of these men. Just after the turn of the century he was collaborating with Dr. C. P. Steinmetz in experiments on the banks of the Kalamazoo River in Michigan, seeking to learn about breaking 40-kv transformer excitation and line charging currents in air. A few years later, in 1907, he worked with Dr. E. M. Hewlett of General Electric on the first 110-kv line, from Croton to Grand Rapids, Mich. Three years later, he was engaged in the significant 140,000-volt Ausable River Transmission Project, the transformers for which were developed here in Pittsfield and from which came a much better understanding of high-voltage apparatus design.

"As voltages have climbed, the size of the project required to furnish necessary data upon which designs can be based has increased manyfold. The Tidd and Leadville Projects have in recent years contributed to our store of information on high-voltage transmission. Several projects in Europe also have made their contributions.

"Now, why do we engage in these expensive enterprises? Why not employ these much-publicized digital computers which calculate at dizzy speeds? The answer is that the computer must have data upon which to work and these data must be significant for the new extra-high-voltage conditions. We must have all the facts that appertain to the untried realm of the higher operating voltage under which operating conditions are to be experienced.

"This cannot be determined by extrapolation of the very best of data on lower voltage systems. The scale effect itself, the necessity for larger physical dimensions and spacings, may bring into play new and unsuspected factors at extra-high voltages. Actual operation of these high-scale lines and equipment will reveal these factors. Then the computers can go to work. After this, the facilities of the project can demonstrate the validity of the results of these computations.

"Controlled experimentation and repetitive demonstration will enable engineers to work out economical designs so that those who invest in the business of power transmission will do so with confidence of successful operation. Thus, through experimentation, analysis, synthesis, and demonstration, we may attain a new plateau of achievement in electric power transmission.

"It is a pleasant opportunity to wish the participating companies success in this newest of extra-high-voltage study projects. They are to be congratulated on their foresight and dedication to the advancement of the knowledge of the art of electric power transmission."

Remarks of L. R. Gaty

"A major step forward is being taken by General Electric Company as the electric power industry stands on the threshold of a dynamic growth in the use of electric energy. Our product must be made available to our customers in even greater quantities, with the highest reliability and at the lowest cost consistent with the best service standards. The major transmission link is a vital part of this picture and ways must be found to move greater quantities of energy in the most efficient manner.

"It is extremely interesting to see how our industry and how the engineering profession goes forward on the basis of boundaries or plateaus. It was about 10 years ago when many of the high-voltage laboratories of the educational institutions of this country were discontinued. At that time, the explanations of educators and of many well-placed engineers in the profession was that all was known that was needed to be known about extra-high voltage, and that when the time came to go to the higher voltages, industry could go forward on the basis of knowledge that was already available.

"It is interesting that within such a short period after that general statement was made and after the discontinuation of these high-voltage laboratories, we are gathering together to take part in the ceremony for a project in which the frontiers of knowledge will be pushed a little farther ahead and new knowledge generated that, when the time comes, will permit us to build the high-voltage, high-reliability, stormproof lines, utilizing the

L. R. Gaty

rights-of-way, high efficiencies, and permitting the economic transmission of large quantities of power over long distances. The use of high-voltage transmission at 287 kv and above now exceeds 2,500 circuit miles and is growing rapidly. Voltages in excess of 500 kv are not many years away and this project will give us the knowledge needed to go forward with confidence when necessary."

Other Speakers

Ceremonies were opened by Lynn Wetherill (F '48) of the General Electric power transformer department, followed by J. W. Seaman (F '58), general manager of the department which is co-ordinating the work of some 15 other departments of the company. P. A. Abetti (M '55), manager of Project EHV, explained that much of the equipment for 650-kv operation has been designed. The time table calls for erection of three portal towers this year, which lend themselves more easily to the stringing of different conductors for test purposes. This section, six tenths of a mile long, is expected to be energized in

the 400- to 450-kv range next spring. While open-end tests are under way, the remainder of the line for 3.6 miles will be built with conventional towers in 1960. In 1961, the second substation will be built and terminal equipment installed to tie into the Western Massachusetts Electric Company's transmission system. Voltages will be raised in steps to the 650-kv level (750 kv maximum). Co-operating companies in Project EHV are Western Massachusetts Electric Company, Stone & Webster Engineering Corporation, Aluminum Company of America, American Bridge Division of U. S. Steel Corporation, Anchor Metals, Inc., Peterson Engineering Company, Rilco Laminated Products, and Weyerhaeuser Timber Company.

Joint Conference on Automatic Techniques

THE 2nd Annual Joint Conference on Automatic Techniques, sponsored jointly by AIEE, American Society of Mechanical Engineers (ASME), and Institute of Radio Engineers (IRE), was held at the Hotel Pick-Congress in Chicago, Ill., May 11-13, 1959. The second of a series to be held annually, the Conference was devoted to a discussion of tools and methods available for introducing automatic techniques in manufacturing industries, process industries; in sorting and handling; and in the processing of business data.

Preparation of the Conference lay in the hands of a steering committee representing the sponsoring societies and consisting of M. Bradner, ASME, The Foxboro Company; J. E. Eiselein, IRE, Radio Corporation of America; R. S. Gardner, AIEE, assistant secretary, technical activities; G. W. Heumann, AIEE, General Electric Company; F. D. Snyder, AIEE, Westinghouse Electric Corporation.

Joint general co-chairmen of the Conference were J. N. Banky, Allis-Chalmers Manufacturing Company, and G. W. Heumann. The Technical Program Committee, under the chairmanship of G. W. Knapp, General Electric Company, consisted of L. W. Herchenroeder, Westinghouse Electric Corporation; V. O. Johnson, U. S. Rubber Corporation; and W. R. Thurston, General Radio Corporation. Publicity was in the hands of F. D. Snyder.

D. B. Klapper, Commonwealth Edison Company, acted as Conference treasurer. In making the local arrangements, J. N. Banky was assisted by a committee which consisted of H. B. Bunce, J. T. Ellis, T. E. Johntz, T. R. Kroeschell, R. J. O'Brien, C. Pigue, E. A. Roberts, and M. Sussman.

Technical Sessions

The morning session on Monday, May 11, chairmanned by G. W. Knapp, was devoted to a discussion of automatic techniques in steel making. G. W. Heumann, who opened the session with welcoming remarks, reviewed the joint effort of the sponsoring societies and pointed out that the Conference is intended to provide a forum at which designers of industrial equipment may lay before the users' engineers the tools and techniques which have become available.

R. W. Barnitz, Jones & Laughlin Steel Corporation, and G. E. Terwilliger, General Electric Company, presented a paper "Application of Data Logging and Programming Techniques to Steel Mill Processes," which reviewed present accomplishments and future trends for data logging and programming techniques in the steel mill areas of reversing hot mills, tandem hot and cold mills, and processing lines.

H. G. Fosdick, U. S. Steel Corporation, gave a paper "Shaping Steel in a Programmed Mill," which dealt with the hot rolling of structural shapes.

A paper by C. T. Zimmermann, U. S. Steel Corporation, entitled "Productivity Improvement through Automatic Control Techniques," presented a review of steel making processes in terms of rapidly expanding technological advances in the areas of mechanization, automatic feedback control, integrated data processing, and computer techniques.

During luncheon, M. Holowati, Inland Steel Company, made some observations on Soviet steel making based on a recent inspection trip through the USSR.

L. W. Herchenroeder presided during an afternoon session devoted to automatic techniques in manufacturing. W. W. Kuyper, General Electric Company, in his paper "Financial Justification of Automatic Machine" discussed the basic principles of financial justification of automatic manufacturing equipment.

W. E. Brainard, Kearney & Trecker Corporation, presented a paper "Application of Numerical Control for Automatic Manufacturing in General Industry," which dealt with numerical control for metal cutting involving the selection of tools and the positioning of the work piece.

C. N. Bell and I. Hosek, Ford Motor Company, in their paper "Static Control and Automatic Transmissions" reported on practical experiences with static control in a large manufacturing plant making automobile transmissions.

The morning session on Tuesday, May 12, chairmanned by V. O. Johnson, was devoted to automatic business data handling. B. W. Taunton, First National Bank of Boston, Mass., presented a paper "Automatic Techniques in Banking," which described how one of the larger banks in the country reached the decision to install a large-scale computer system.

W. Prince, General Electric Company, presented a paper "High Speed Banking Automation" which described the magnetic ink symbol recognition as the heart of high-speed banking operation.

J. D. Gallagher, Sylvania Electric Products, presented a paper "Data Processing—Its Role in Administration," which describes an evaluation study launched in 1953 by Sylvania Electric Products to determine how data-processing equipment could fit into the company's long-range planning program.

During luncheon, T. Schneider, First National Bank of Chicago, discussed the business outlook.

W. R. Thurston acted as chairman of the afternoon session dealing with automatic techniques and sorting and handling. The first paper presented was "Automation in Railroading," by V. E. McCoy, Chicago, Milwaukee, St. Paul & Pacific Railroad.

"The Mail-Flo System of the United States Post Office Department," by S. C. Skeels, U. S. Post Office Department, describes the Mail-Flo System—an integrated arrangement of conveyors and control equipment which automatically transports batches of letter-size mail in trays

PARTICIPANTS in the 2nd Annual Joint Conference on Automatic Techniques, sponsored by AIEE, ASME, and IRE, May 11-13, 1959, at the Hotel Pick-Congress, Chicago, Ill.

on conveyors from one serving station to another.

A paper "Mechanization of the Job Shop," by W. Willets, Western Electric Co., defines the materials handling problems related to stores and manufacturing operations in a massive job shop of nearly a million and a half square feet and describes in some detail the operation of several systems developed to solve these problems.

The morning session on Wednesday, May 13, under the chairmanship of G. W. Knapp, was devoted to automatic techniques in the processing industry. The first paper, by P. D. Schnelle, E. I. du Pont de Nemours & Co. (Inc.), entitled "Data Gathering and Continuous Chemical Processing," outlines the need for information required for controlling chemical processes and describes the means for measuring important process variables.

G. P. Russell and T. J. Shuff, Monsanto Chemical Company, presented a paper "Use of Data Logging in Chemical Processing," which describes equipment features and specifications for data logging equipment.

"An Optimizing Control for the Process Industries," by D. A. Burt, Westinghouse Electric Corporation, describes a new concept in the field of process control.

The Conference was concluded with an inspection trip to the Hotpoint Plant during the afternoon. This inspection trip covered the department devoted to the manufacture of electric ranges. Many examples of automated and mechanized equipment for the manufacture and assembly of component parts and subassemblies were demonstrated.

Next Conference

The next Conference on automatic techniques will be held in Cleveland, Ohio, April 18-19, 1960. The Sheraton-Cleveland Hotel will be the meeting place. This Conference will again be sponsored jointly by AIEE, ASME, and IRE.

Paper Preprints

Preprints of the papers presented at the Chicago Conference can be obtained from AIEE or ASME Headquarters. Members of AIEE, ASME, and IRE are entitled to receive copies of all papers at the regular member price of 40¢ per copy from ASME and 50¢ per copy from AIEE.

Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. N. S. Hibshman, Secretary, 33 West 39th Street, New York 18, N. Y.

The following papers can be obtained by writing to AIEE, 33 W. 39th St., New York 18, N. Y.: CP59-516, W. W. Kuyper; CP59-631, G. P. Russell and T. J. Shuff; CP59-632, V. E. McCoy; CP59-633, P. D. Schnelle; CP59-634, B. W. Taunton; CP59-636, W. Prince; CP59-637, J. D. Gallagher; CP59-638, S. C. Skeels; CP59-795, H. G. Fosdick.

The following papers can be obtained by writing to ASME, 29 W. 39th St., New York 18, N. Y: 59-AUT-1, W. Willets; 59-AUT-2, C. N. Bell and I. Hosek; 59-AUT-3, W. E. Brainard; 59-AUT-4, D. A. Burt; 59-AUT-5, R. W. Barnitz and G. E. Terwilliger; 59-AUT-6, C. T. Zimmermann.

Report of the AIEE Board of Directors*
May 1, 1958—April 30, 1959

THREE MEETINGS of the AIEE Board of Directors were held in Buffalo, N. Y.; Sacramento, Calif.; and in New York, N. Y. The Executive Committee met four times: twice in New York, N. Y.; once in Akron, Ohio; and once through a telephone conference during which the cancellation of the Fall General Meeting in Pittsburgh, Pa., was discussed. Information regarding the more important decisions of the Board were reported in various issues of *Electrical Engineering*.

Three General Meetings of the Institute were held: Summer, Buffalo, N. Y.; Pacific, Sacramento, Calif.; and Winter, New York, N. Y. The usual Fall Meeting was cancelled because of a hotel employees' strike in Pittsburgh, Pa.

Five District Meetings were held: Great Lakes, East Lansing, Mich.; East Central, Huntington, W. Va., and Akron, Ohio; South East and South Central (combined), Atlanta, Ga.; and Empire, Syracuse, N. Y.

The Institute wholly or partly sponsored 33 special technical conferences and the total attendance at all meetings and conferences was 45,323, a total of 2,592 papers being presented.

Constitution and Bylaws Committee

Rewritten and rearranged drafts of the Constitution were submitted to the Board at its meeting of June 27 and August 21, 1958. The final draft, dated January 5, 1959, was adopted by the Board at its meeting on February 6, 1959. It will be submitted to the membership for ratification.

During the year, the Committee changed various sections of the Bylaws, as approved by the Board. A complete revision and renumbering of the Bylaws will be undertaken by the Committee in order to produce them in a format similar to the new Constitution.

Finance Committee

Because of the decrease in advertising income and an increase in the number of pages in the bimonthly publications and *Transactions* beyond the amounts budgeted, the Institute's expenditures this year exceeded the income. This required some short-term financing at the end of the fiscal year to avoid selling some securities.

Financial assistance was furnished by the Institute to Engineers Joint Council (EJC), Engineers' Council for Professional Development (ECPD), and the Nuclear Congress. The automation of office procedures is progressing and producing results hitherto unobtainable. The program of collecting data, graphic presentation of the Institute's financial situation, and periodic comparison of past and present finances is continuing to achieve the best long-range financial plan.

For the Institute's balance sheet and the statement of income and operating fund reserve for the fiscal year ending April 30, 1959, see the end of this summary.

Planning and Co-ordination Committee

The work of this Committee at its four meetings during the year was directed along the following lines: a special registration fee of $2.00 per day at the Winter General Meeting; types of committees and appointment methods; Board Meetings and Executive Committee powers; creation of a 75th Anniversary Committee; rules and procedures and the implementation of the latter; organization of the Institute.

Public Relations Committee

This Committee co-operated with the Institute's 75th Anniversary Committee in publicizing the AIEE Diamond Jubilee. This was in addition to its regular work of writing and publishing new literature, revising existing booklets and pamphlets, publicizing Institute meetings and conferences as well as awards, elections, and appointments.

More than 500 digests, news releases, and feature articles were prepared and distributed to the trade and general press, radio, and television.

Sections Committee

The number of Sections remains at 112 and the number of Subsections has increased to 77.

*This is a summary of the Report of the Board of Directors. Anyone wishing a copy of the complete report should write to: The Secretary, AIEE, 33 W. 39th St., New York 18, N. Y. Copies of the complete report have been mailed to the chairmen of all general and technical committees of the Institute.

The first and second places of the Section Growth Awards were won by the St. Louis and Portland Sections in the larger-than-average group and in the smaller-than-average group by the Tampa and Rochester Sections, respectively.

The total number of meetings decreased from 2,606 in 1958 to 2,011 in 1959, but the total attendance increased to 139,393 in 1959, about 2,000 more than in the previous year.

Student Branches Committee

AIEE student membership increased to 11,616 as of May 1, 1959. There are now six new branches, bringing the total to 163, which held 1,465 meetings during the year with a total attendance of 100,846.

Admission and Advancement Department

The problem of handling applicants with foreign educational background has been alleviated by the selection of a list of European universities whose educational standards are on an ECPD level.

An Institute-wide membership month has been scheduled for November, giving local Sections the benefit of national publicity in their efforts to increase membership.

Board of Examiners

In the period 1958-59, the Board acted upon 11,814 applications for membership or transfer from one grade to another, which is an increase of 798 over the previous year.

Membership Committee

The total membership of the Institute as of April 30, 1959, was 53,827, an increase of 1,614 members, slightly less than the increase of the previous year. New members increased 5.4%, but former members re-elected declined from last year's figure.

Medals and Awards

The following Institute medals and awards were made during 1958-59:

Edison Medal to Dr. Charles F. Kettering (posthumously).

Lamme Medal to P. L. Alger and Sterling Beckwith, both consulting engineers.

AIEE Medal in Electrical Engineering Education to J. F. Calvert, University of Pittsburgh.

Charles LeGeyt Fortescue Award to Ira Richer, Rensselaer Polytechnic Institute.

John Fritz Medal to Mervin J. Kelly, Bell Telephone Laboratories.

Elmer A. Sperry Award to Dr. Ferdinand Porsche (posthumously), Dr. Heinz Nordhoff, and their coworkers in Volkswagenwerk.

Washington Award to James R. Killian, Jr., First Special Assistant for Science and Technical Research.

Marston Medal to Murray Joslin, Commonwealth Edison Co.

Recognition Awards Committee

Designs were completed for the Morris E. Leeds Award certificate and also for the medal and certificate for the William M. Habirshaw Award.

The Award in Electrical Engineering Education will consist of a bronze medal and a stipend of $500 instead of the 10-carat gold medal presented previously.

Preliminary study has been given to the administration of two new awards: the David Sarnoff Award in Electronics, consisting of a gold medal, a bronze replica, and certificate, and the Mervin J. Kelly Award in Telecommunication, consisting of a bronze medal, stipend of $1,000, and a certificate.

Publications Department

Since the three technical periodicals issued bimonthly were started in 1952, the number of pages has increased 70%, the circulations have about doubled, and the total costs have risen nearly 144%. Because of these trends, the Department recommended to the Board of Directors an annual subscription price of $5.00 for each publication to members and $8.00 to nonmembers. The Board reduced the price to $2.50 for the first publication and kept the $5.00 price for each of the other two to members starting May 1, 1959.

Electrical Engineering. A special issue containing 22 articles by outstanding engineers was published in May 1959, commemorating the Institute's 75th Anniversary. During 1959, each issue contained "A Salute to the AIEE," written by an outstanding leader in the United States. Messages were published from President Eisenhower, ex-president Herbert Hoover, Dr. J. R. Killian, Jr., and others.

At the close of the calendar year 1958, the advertising in *Electrical Engineering* has decreased 26.6% by volume compared with 1957. This decline is similar to the experience of other society and commercial publications because of the business recession.

Special Publications. During the year, 14 special publications were issued with a total of 1,656 pages. Six of these were proceedings of Special Technical Conferences.

Technical Operations Department

In addition to its seven standing subcommittees and five-man Administrative Committee, this Department established in 1958-59, five new subcommittees and two general committees to meet its growing needs.

The new subcommittees are:

Mid-West. To provide a broader geographical liaison with TOD from Cleveland to Omaha and from Canada to the Gulf of Mexico.

Outside Organization Relations. To investigate and provide recommendations regarding TOD appointments and appropriations for outside organizations.

Publications. To determine if it is practicable for one technical committee to have its own publication; policy considerations in publications of Special Technical Conferences; reduction in price of preprinted technical papers.

TOD Statistics. To develop significant statistics and relationships for meeting sessions and various types of papers to detect and provide statistical guidance.

West Coast. To guide, encourage, and stimulate effective West Coast activities in harmony with national efforts.

The two new general TOD committees mentioned previously are one on New Technical Activities to find new technology in electrical and related fields, and one on Automation and Data Processing.

Man–Machine Integration Committee

This Committee, founded in August 1958, has as its objective ". . . to optimize the match between machine and human being so that the performance of the combined man-machine system has maximum practical effectiveness and efficiency." This Committee is a functional cross section of AIEE activities, as its work cuts across such device areas as power system distribution, air traffic control, telephone switching, air defense systems, and focuses on functional points of view that are common to these areas. The Committee plans a session at the next Fall General Meeting.

Nuclear Congress and Nucleonics Committee

This Committee was formed to explore and co-ordinate the Institute's interest in the nuclear field and to be a liaison between AIEE and other technical societies, Government, state, and international activities contributing to the expansion of this new technology.

Research Committee

A brochure, "An Invitation to Research," was prepared and distributed to ECPD accredited engineering schools encouraging the undertaking of research projects related to the electrical engineering field, and outlining ways in which the Research Committee can assist in developing proposals and obtaining financial support.

One proposal for research on electric breakdown phenomena submitted by Prof. G. W. Penney, Carnegie Institute of Technology, to the National Science Foundation has been endorsed by the Committee.

Safety Committee

To implement further the Committee's assignment, the Liaison Representatives Subcommittee has been reactivated so that the program of the Safety Committee will be carried into each Institute Division.

Interest in better engineering correlation between the National Electrical Code and the Canadian Electrical Code has been endorsed by the Board of Directors.

Technical Committees

The Report contains detailed reports from 48 of the Institute's technical committees, concerning their activities for 1958-59.

Representatives

The Report includes reports on the year's activities from the following: AIEE-IRE (Institute of Radio Engineers) Coordinating Committee on Student Activities, Council of the American Association for the Advancement of Science, American Automatic Control Council, American Standards Association, Electrical Historical Foundation, EJC, ECPD, International Illumination Commission, United Engineering Trustees, Inc., U. S. National Committee of the International Electrotechnical Commission, and U. S. National Committee of the World Power Conference.

HASKINS & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

TWO BROADWAY
NEW YORK 4

Accountants' Report

American Institute of Electrical Engineers:

We have examined the balance sheet of American Institute of Electrical Engineers as of April 30, 1959 and the related statements of income and operating fund reserve and of restricted fund reserves for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statements of income and operating fund reserve and of restricted fund reserves present fairly the financial position of the Institute at April 30, 1959 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(signed) ***Haskins & Sells***

June 15, 1959

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit A — **Balance Sheet, April 30, 1959 and 1958**

ASSETS

	April 30, 1959	April 30, 1958
Property Fund Assets:		
Founder Society advances to United Engineering Trustees, Inc. (not repayable except upon latter's dissolution; 4% interest payable from date of occupancy of United Engineering Center)	$ 265,000	$ 265,000
Other properties at nominal values (library, works of art, etc.)	16	16
TOTAL PROPERTY FUND ASSETS	$ 265,016	$ 265,016
Restricted Fund Assets:		
Investments:		
Securities (market value, 1959—$1,773,641; 1958—$1,151,720)	$1,266,882	$ 835,288
4¼% note of United Engineering Trustees, Inc.		340,000
Cash	17,140	18,593
Accrued interest purchased		92
TOTAL RESTRICTED FUND ASSETS	$1,284,022	$1,193,973
Operating Fund Assets:		
Cash	$ 163,743	$ 84,791
Accounts receivable:		
Members—for dues	39,510	46,016
Advertisers	5,402	5,740
Technical conference loans	9,350	9,597
Subscriptions, etc. (less reserve, 1959—$2,797; 1958—$3,000)	47,170	44,962
Inventories—at cost or less:		
Transactions	20,232	19,639
Text and cover paper	32,777	35,335
Badges	3,771	4,577
Production charges for May and subsequent issues of *Electrical Engineering*	39,540	18,850
Prepaid expenses	15,828	4,743
Office equipment, furniture, and fixtures (less reserve for depreciation, 1959—$77,831; 1958—$71,808)	40,427	40,156
TOTAL OPERATING FUND ASSETS	$ 417,750	$ 314,406
TOTAL	$1,966,788	$1,773,395

LIABILITIES

	April 30, 1959	April 30, 1958
Property Fund Reserve:		
Founder Society advances to United Engineering Trustees, Inc.	$ 265,000	$ 265,000
Other	16	16
TOTAL PROPERTY FUND RESERVE	$ 265,016	$ 265,016
Restricted Fund Reserves:		
Reserve Capital fund	$1,198,479	$1,113,154
Member-for-Life fund	32,564	29,748
International Electrical Congress of St. Louis Library fund	6,615	6,611
Edison Medal fund	11,265	10,819
Edison Endowment fund	7,986	7,986
Lamme Medal fund	9,727	9,700
Mailloux fund	1,054	1,051
Volta Memorial fund	12,783	12,663
Kettering Award fund	2,274	2,241
Habirshaw Medal fund	1,275	
TOTAL RESTRICTED FUND RESERVES	$1,284,022	$1,193,973
Operating Fund Reserve, Liabilities, etc.:		
Accounts payable	$ 109,963	$ 68,283
Accrued expenses	7,172	28,098
Deferred income, etc.:		
Dues	298,713	67,546
Subscriptions to publications, etc.	62,286	58,206
Other	5,550	6,960
Operating fund reserve (deficit) (Exhibit B)	(65,934)	85,313
TOTAL OPERATING FUND RESERVE, LIABILITIES, ETC.	$ 417,750	$ 314,406
TOTAL	$1,966,788	$1,773,395

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

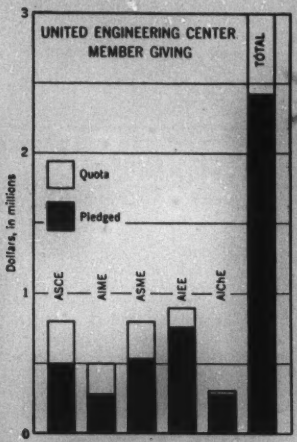
Exhibit B **Statement of Income and Operating Fund Reserve for the Years Ended April 30, 1959 and 1958**

	April 30, 1959	April 30, 1958
Income:		
Dues:		
Members	$ 876,335	$ 842,927
Students	46,091	42,638
	$ 922,426	$ 885,565
Fees:		
Entrance	$ 20,209	$ 20,744
Transfer	5,040	5,325
	$ 25,249	$ 26,069
Publications sales:		
Advertising	$ 414,655	$ 511,211
Electrical Engineering subscriptions, etc.	42,163	42,607
Transactions volumes	34,329	33,469
Bimonthlies subscriptions, etc.	37,428	27,912
Preprints, special and technical publications, etc.	86,539	82,833
	$ 615,114	$ 698,032
Other income:		
Meetings registration fees	$ 35,103	$ 50,675
Technical conferences—net	3,761	22,771
Income from investments:		
Reserve Capital Fund—Marketable securities	46,109	40,332
Reserve Capital Fund—Note of United Engineering Trustees, Inc.	7,013	10,540
Other (net of interest expense $277)	166	—
Standards sales (including binders)	19,193	23,930
Sale of member emblems	719	676
Miscellaneous	3,069	1,286
	$ 115,133	$ 150,210
TOTAL INCOME	$1,677,922	$1,759,876
Expenses:		
Administration Department:		
Public Relations	$ 37,367	$ 38,269
Sections	161,198	153,132
Student Branches	44,473	38,654
Other	29,126	23,610
	$ 272,164	$ 253,665
Admission and Advancement Department:		
Membership	$ 12,894	$ 15,642
Other (including salaries, 1959—$27,594; 1958—$26,821)	28,534	26,821
	$ 41,428	$ 42,463
Professional Development and Recognition Department	$ 15,285	$ 12,047
Technical Operations Department:		
Institute Meetings	$ 77,715	$ 68,028
Technical Activities	31,691	28,914
Standards Committee	18,136	37,906
Other	5,320	4,795
	$ 132,862	$ 139,643
Forward	$ 461,739	$ 447,818

	April 30, 1959	April 30, 1958
TOTAL INCOME (Forward)	$1,677,922	$1,759,876
EXPENSES (Forward)	$ 461,739	$ 447,818
Publications Department:		
Electrical Engineering:		
Advertising	$ 254,726	$ 279,041
Text	202,935	205,733
Transactions volumes	50,163	42,965
Bimonthlies	204,454	165,752
Membership directory and organization manual	21,606	26,639
Preprints, special and technical publications, etc.	126,950	108,446
	$ 860,834	$ 826,576
TOTAL DEPARTMENT EXPENSE	$1,322,573	$1,274,394
Non-Department Expense:		
General:		
Salaries	$ 208,585	$ 195,053
Postage	7,087	7,947
Stationery and supplies	18,061	17,684
Contributions under retirement plan	28,741	22,098
Social Security taxes	8,228	7,757
Legal fees	500	550
Travel expenses of Directors and President	13,299	16,415
Depreciation of equipment, etc. (including accelerated depreciation, 1959—$557; 1958—$7,030)	6,572	13,486
United Engineering Trustees, Inc.:		
Building assessments (exclusive of amounts charged to other accounts, 1959—$10,986; 1958—$10,507)	36,961	35,269
Library assessments and pension	29,933	27,207
Rental of equipment	12,736	4,772
Conversion costs to punched cards	1,679	11,574
Provision for doubtful accounts	—	3,000
Other	35,411	28,772
	$ 407,793	$ 391,584
Institute Districts	6,961	6,085
Constitution and Bylaws Committee	3,043	421
Finance Committee	2,200	1,924
Planning and Coordination Committee	48	155
Intersociety Relations Committee	1,238	—
TOTAL NON-DEPARTMENT EXPENSE	$ 421,283	$ 400,169
TOTAL EXPENSE	$1,743,856	$1,674,563
Excess (deficit) of Income over Expenses for the Year	$ (65,934)	$ 85,313
Operating Fund Reserve, May 1	85,313	198,387
TOTAL	$ 19,379	$ 283,700
Transfer to Reserve Capital Fund	85,313	198,387
Operating Fund Reserve (deficit) April 30	$ (65,934)	$ 85,313

Contract Signed for United Engineering Center

REPRESENTATIVES OF THE UNITED ENGINEERING TRUSTEES (UET) and the Turner Construction Company signed a contract on May 28, 1959, for the erection of a $10 million, 18-story United Engineering Center in New York City. Shown at the contract signing, which took place at the Engineers Club, 32 W. 40th St., New York, N. Y., are *(seated, left to right)*: W. F. Thompson, chairman, Real Estate Committee of UET; Andrew Fletcher, president of UET; E. K. Abberley, vice-president of Turner Construction Company; *(standing, left to right)*: H. C. Bernhard, partner, Shreve, Lamb & Harmon Associates, Architects; and W. B. Ball, vice-president and secretary of Turner Construction Company. The Center, to be located between 47th and 48th Streets on United Nations Plaza opposite the United Nations, will house many of the nation's major professional engineering groups superceding the 50-year-old Engineering Societies Building on 39th Street. Ground breaking for the new structure is scheduled for this Fall. According to United Engineering Trustees, the structure will be ready for occupancy in 1961. Among the occupants will be: AIEE, American Society of Civil Engineers, American Institute of Mining, Metallurgical and Petroleum Engineers, American Society of Mechanical Engineers, American Institute of Chemical Engineers, American Institute of Consulting Engineers, American Institute of Industrial Engineers, Society of Women Engineers, American Welding Society, and American Society of Heating, Refrigerating and Air-Conditioning Engineers.



THE BAR GRAPH shows the status of member giving as of June 19, 1959. All contributions to the United Engineering Center Building Fund are tax deductible.

Date Set for Western Computer Conference

May 3, 4, and 5 are the dates established for the 1960 Western Joint Computer Conference to be held in San Francisco, Calif., next year. The Conference sponsors are the AIEE, Institute of Radio Engineers, and the Association for Computing Machinery.

Following the successful pattern of the 1959 Conference also held in San Francisco last March, the program will be developed along lines reporting on new computer technology.

Theme for the Conference will be "Computers—Challenge of the Next Decade."

R. M. Bennett, Jr., of IBM Research Laboratories, San Jose, is general chairman. G. A. Barnard, III, of Ampex Corp., Redwood City, is vice-chairman.

Planning of the technical program will be headed by H. M. Zeidler of Stanford Research Institute, Menlo Park.

Inquiries relative to the Conference are being received at Box 214, Station A, Palo Alto, Calif.

Michigan Section Celebrates the AIEE's 75th Anniversary

The fifth annual Ladies Day of the AIEE Michigan Section and a 75th Anniversary Celebration of the founding of the Institute was held Tuesday afternoon and evening, May 12, 1959, at the Consumers Power Company's Employees Clubhouse, Clarklake, with more than 80 members and guests attending.

From midafternoon on, the boating facilities and other outdoor sports equipment of the club were enjoyed.

The afternoon portion of the program concluded with an electronic range demonstration, "Cooking with Your Hat On," by Mrs. Harriet Cookson and Miss Marilyn Brier, Home Service Advisers.

Dinner, in keeping with the informality of the day, featured a main course of fried chicken. Mrs. C. R. French and her committee prepared nosegays for the ladies and flower arrangements for the tables. Mr. and Mrs. Campbell, clubhouse hosts, provided the floral decoration for the speakers' table.

After the main dinner course, J. W. Eakins, 1958-59 Michigan Section chairman, spoke a few words of welcome and introduced A. W. Rauth, who delivered a brief message in commemoration of the AIEE and its 75th Anniversary. Mr. Rauth, who is supervisor of the General Meter and Laboratory, Consumers Power Company, assumes the vice-presidency of the Institute's District No. 11 this August.

Mr. Rauth cut the 75th Anniversary cake, after which the members were served.

Several electric appliances were awarded as door prizes. There were also awards for newest AIEE member present, Ken Jamison, Westinghouse Electric Corporation, Detroit, and AIEE member of longest standing, D. R. Stratton, Commonwealth Associates Inc., Jackson. Mr. Eakins requested each couple to stand, informally introduce themselves, give company affiliation, and state their locality. Mr. Eakins introduced those at the speak-

ers' table, including J. J. Fredrickson, General Electric Company, Jackson, vice-chairman of the Michigan Section.

Mr. Fredrickson introduced Walter "Andy" Anderson, the featured entertainer of the evening. "Andy" presented his "Laugh It Off" talk, invoking alternately laughter and sober reflection from his audience as he gave his ideas on using humor as a tonic for overcoming problems in our modern world.

Inasmuch as the Ladies' Day Meeting was the final gathering of the season for the Michigan Section, Mr. Eakins introduced B. H. Schneider, The Detroit Edison Company, chairman-elect, 1959-60. Mr. Schneider responded, and among his first acts as chairman presented to Mr. Eakins on behalf of the Michigan Section membership a framed certificate in recognition of his service as chairman and also a suitably engraved past chairman's lapel pin.

The other incoming Section officers are as follows: H. S. Mika, Ford Motor Company, vice-chairman; J. J. Fredrickson, General Electric Company, secretary-treasurer. Directors for the 1959-60 term will be: A. C. Fagerlund, F. F. Klaes, R. F. Noonan, C. R. Seibert, B. L. Traeger, and M. C. Westrate.

A. J. Hoffmeister, Westinghouse Electric Corporation, Jackson, was program chairman. Assisting in arrangements were: K. J. Goss, G. W. Tripp, G. L. Heins, and C. R. French, all of the Consumers Power Company.

Announcement

Preprint Prices Increased

THE PRIMARY PURPOSE of preprinting Transactions and Conference Papers is to make them available to members in advance of meetings at which they are presented so that discussion may be prepared. The price of preprints to members is set with the intention of covering the cost of the service. Demand varies widely and is not readily predictable; therefore, only minimum quantities of each paper are stocked. Quantity orders received after the first printing often require reprinting and duplication of first costs, so that quantity orders do not necessarily permit lower prices.

Increasing costs of printing, handling, and mailing have resulted in this service becoming a burden on funds of the Institute intended for expanding more general services to members. The Board of Directors has therefore ordered an adjustment in preprint prices, effective August 1, 1959, as shown in the following schedule.

For AIEE Members ..... $ .50 each

For Nonmembers of AIEE

Individuals ..... $1.00 each
Companies, Governments, Libraries, etc. ..... $1.00 each

Orders from individuals *must* be accompanied by remittance in full.

Orders from Companies, Governments, Libraries, etc., placed in the name of an individual AIEE member will be honored at member rates shown above *only* when accompanied by remittance in full and when no receipt or invoice is requested.

The above prices do not hold for quantity orders of 25 or more copies of any one paper. Quotations must therefore be obtained.

For special rates to Authors refer to latest edition of Author's Guide.

MICHIGAN SECTION celebrated the 75th Anniversary of the founding of the Institute at a meeting on May 12. At the cake cutting ceremonies (above, *left*) are (*left to right*): Walter "Andy" Anderson, Mrs. J. W. Eakins, J. W. Eakins, A. W. Rauth, and Mrs. B. H. Schneider. Above, *right*: B. H. Schneider (*left*), incoming chairman of the AIEE Michigan Section, presents a past chairman's certificate to J. W. Eakins (*right*).

Conference Papers Open for Discussion

Conference papers listed below have been accepted for AIEE *Transactions* and are now open for written discussion until August 24. Duplicate double-spaced typewritten copies of each discussion should be sent to E. C. Day, Assistant Secretary for Technical Papers, American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y., on or before August 24.

58-449 High-Strength Aluminum-Alloy Conductors. *E. W. Greenfield*

59-263 230-Kv vs 60-Kv Subtransmission. *V. W. Ruskin, A. Langmuir*

59-651 An Unusual Method for Replacing a Rotor Spider in a Water-Wheel Generator. *W. R. Small, Jr., P. M. Bell*

59-803 Amplitude Build-up During Acceleration of Oscillatory Systems Possessing Several Degrees of Freedom. *O. I. Elgerd*

Preprints may be purchased at 50¢ each to members, $1.00 to nonmembers, if accompanied by remittance or coupons. Please order by number and send remittance to: AIEE Order Department, 33 West 39th St., New York 18, N. Y.

7th National Conference U. S. National Commission for UNESCO

The 7th National Conference of the U. S. National Commission for UNESCO will take place September 29–October 2, 1959, in Denver, Colo. The theme of the Conference is "The Cultures of the Americas: Achievements in Education, Science, and the Arts."

The central objective of the Conference is to further, within the United States, a greater interest in and understanding of the Latin American peoples and cultures, and, at the same time, demonstrate to Latin Americans how sincerely and extensively this interest already finds expression in the United States. In pursuing that objective, the Conference will examine organizations and techniques developed in the Western Hemisphere which strengthen cultural ties and increase solidarity among its peoples and will discuss ways in which all Americans can contribute toward inter-American co-operation.

At the invitation of the U. S. National Commission, the Conference will be composed of some 2,000 individuals and representatives of organized bodies.

Delegates will be addressed at general and section plenary sessions by Latin American and United States leaders.

Following the first general plenary session, the Conference will be divided into three major sections: education, science, and culture, with two 1-day sessions on balanced economic growth and on international organizations, which in turn will divide into panels.

The program for the Science Section, under the chairmanship of Dr. A. K. Manchester, and developed by an advisory committee under the auspices of the National Academy of Sciences, will center on the theme, "Co-operation of the Scientists and Engineers of the Americas in Furthering Scientific Training and Research." On the first day, the discussions will be devoted to the "Organization and Structure of Institutions of Higher Learning in Latin America as They Affect Scientists and Engineers." On the second day, the principal topic to be discussed will be "Opportunities and Responsibilities for Scientific Research Peculiar to Areas of Latin America, Some of Which Might Be Applicable to Other Areas of the World." The discussions for both days of the Science Program will consider ways in which United States scientists and institutions can be of assistance.

Winner of Marston Medal Announced

Murray Joslin (M '46, F '57) was announced at the commencement exercises at Iowa State College on May 29 as the 1959 winner of the Marston Medal. The medal is awarded annually in memory of the late Dean Anson Marston of the Division of Engineering to an alumnus in recognition of outstanding achievement in the field of engineering.

Mr. Joslin, a 1923 graduate in electrical engineering, was born in Independence, Iowa, in 1901. Following his graduation in 1923, he completed 2 years of law at DePaul University and Kent College in Chicago, Ill.

His only employment since graduation has been in Commonwealth Edison Company, Chicago. He has held responsible positions in practically all the activities of the company including engineering, operation, research, public relations, sales, and financial administration. He has served as division operating superintendent, division vice-president, assistant to executive vice-president, and assistant to the president. In 1951, he was placed in direct charge of the nuclear power study group which, working under an agreement

Murray Joslin

with the United States Atomic Energy Commission, developed designs for several different types of nuclear power stations. In 1953, Mr. Joslin was elected financial vice-president, and in this position had responsibility for the financial and corporate activities of the company. In 1955, he became operating vice-president in charge of engineering, construction, production, and research and development, the position which he now holds.

In engineering, Mr. Joslin has been unusually successful in inspiring and directing others. One of his most recent accomplishments has been the direction of a group of utility engineers in pioneering the application of atomic energy to commercial power production. The construction of a $45 million nuclear fueled plant of the boiling water reactor type with 180,000-kw capacity will be completed in 1960.

Mr. Joslin has used his abilities in many civic enterprises. During World War II, he secured needed improvements in the facilities for the Vaughn General Hospital, a veterans' hospital since merged with Hines Hospital in the Chicago area. He is a director of charitable and civic organizations and a member of civic committees for Marquette and Loyola Universities.

The Marston Award, represented by the medal, was established by Iowa State College in 1938. The award was inspired by Anson Marston, professor of civil engineering from 1892-1920, dean of engineering from 1904-1932, and dean emeritus at the time the award was established.

A board of award selects a winner each year. On the board is one representative from each of four engineering societies: AIEE, American Society of Civil Engineers, American Society of Mechanical Engineers, and the American Institute of Chemical Engineers. Four members are engineering alumni, one chosen each year for a 4-year term by the class which is celebrating its 25th year reunion. The dean of engineering of the Iowa State College is ex-officio chairman of the board.

The award is made only to an engineering alumnus of at least 30 years standing. Since 1939, no candidate has been eligible for election until his name had been before the board of award for at least one year. The term "engineering alumnus" means one who has received an earned bachelor's, master's, or doctor's degree in some branch of engineering at Iowa State College.

Eligible for the award are graduates en-

gaged in technical design and construction and those who plan, develop, and manage enterprises in the fields of manufacturing utilities and civic betterment as well as engineering teaching and research, and activities in national engineering societies.

Electric Heating Conference Held at Philadelphia in April

The 4th biennial AIEE National Electric Heating Conference, held in Philadelphia, Pa., April 14-15, 1959, had an attendance of almost 300. The meeting was jointly sponsored by the National Electric Heating Committee and the Philadelphia Section. The group was welcomed by G. B. Schleicher, Philadelphia Electric Company, chairman of the local Section, and M. I. Allen, vice-president sales, Philadelphia Electric Company, who spoke on "Growth of Electric Heat."

Topics covered included: applications of dielectric heating to plastics, rubber, and wall board; mass heating by induction—including cable annealing, uranium billet heating, and axle hardening. Additional subjects were quartz-tube radiant heating in aircraft and missile work; electrode-type salt bath furnaces; high frequency power for heating, welding, hardening, and annealing; induction heat for quenching, and for heavy steel production; utility service to heating loads.

Bound copies of all the papers given at the Conference are available at $3.50 per copy from: A. D. Spillman, Philadelphia Electric Company, 211 S. Broad St., Philadelphia, Pa.

F. T. Chesnut of Yardley, Pa., chairman of the national committee, opened the proceedings. Assisting with the Conference arrangements were: C. A. Tudbury, New Rochelle Tool Co., Conference chairman; A. D. Spillman, Philadelphia Electric Company, local arrangements chairman; K. J. Sorace, Lamson & Sessions Co.; C. P. Bernhardt, Westinghouse Electric Corporation; J. E. Friess, General Electric Company; J. P. Clark, Jr.; G. W. Gordon, Philadelphia Electric Company.

A. S. Barnes, Bell Telephone Company of Pennsylvania was the banquet speaker. His talk "Two Modern Miracles" dealt with a Nike missile installation and a new approach to telephone communication.

ACTIVE in the AIEE National Electric Heating Conference were (*seated, left to right*): A. D. Spillman, Philadelphia Electric Company, local arrangements chairman; A. S. Barnes, Bell Telephone Company of Pennsylvania, banquet speaker; F. T. Chesnut, national committee chairman; C. A. Tudbury, New Rochelle Tool Company, Conference chairman; (*standing, left to right*): J. E. Friess, General Electric Company; W. C. Rudd, New Rochelle Tool Company; K. J. Sorace, Lamson & Sessions Company; G. W. Scott, Jr., Armstrong Company.

Chicago Making Plans for AIEE Fall General Meeting

Plans for the Fall General Meeting to be held at the Morrison Hotel in Chicago, Ill., October 11-16, 1959, have been moving along quite rapidly with many of the social functions, inspection trips, and hotel arrangements settled.

For the first time, the AIEE Meeting will be held jointly with the National Electronics Conference (NEC) under a reciprocal registration agreement. Registration for AIEE will also allow registration at the NEC upon the request of the registrant without additional fee. Registrants at NEC will be able to register for AIEE by payment of the difference in registration fees.

Approximately 68 technical sessions are planned, some to be held jointly with NEC, with integrated inspection trips and social activities. The inspection trips will include Argonne National Laboratories, featuring the EBWR (Experimental Boiling Water Reactor); Fisk Street Station of the Commonwealth Edison Company, featuring a new 325-mw generating unit just installed; High-Voltage Laboratory of Hubbard and Company, with a demonstration of high-voltage testing; Chicago Harbor Authority, with inspection of terminal facilities for the St. Lawrence Seaway; Panellit Products Company, featuring a demonstration of New Data Logging Equipment.

The ladies activities will center around the Chicago Room of the Hotel Morrison which will provide excellent facilities including the lounge, dressing rooms and, of course, a morning coffee hour. Included in the ladies activities are a brunch in the lovely new Carousel Room overlooking

Photo by Gale G. Law

PLANS WERE PROCEEDING rapidly for the AIEE Fall General Meeting to be held in Chicago, Ill., October 11-16, 1959, at the last meeting of the General Committee. The members of the Committee are (*seated, left to right*): E. H. Finch, chairman; Mrs. P. R. Cassidy, ladies activities; D. H. Beal, vice-chairman; L. E. Randall, secretary; J. R. Warren, Fall Frolics; (*standing, left to right*): G. L. Welch, general session; L. E. Ackmann, sale of papers; R. J. Durkin, hotel arrangements; D. J. Sommers, ticket sales; G. G. Law, registration; H. Fossum, trips and transportation; D. E. Skyllingstad, treasurer; F. A. Larson, finance and budget; S. Cluts, publicity; R. J. Krekel, technical program; G. H. Robertson, hospitality.

AIEE Columbus Section Activities

THE COLUMBUS SECTION OF AIEE met in the Ohio Bell Toll Building, May 5, 1959, to hear D. F. Jones and R. P. Palomo of Ohio Bell's engineering department, talk about "Tomorrow's Communications." Mr. Palomo is shown above, left. In discussing what lies ahead in the communications industry, they showed how the building blocks of today's telephone technology—the electromagnetic relay and vacuum tube—will be replaced by the miniature, high-speed, low-powered building blocks of tomorrow's telephone technology, such as semiconductors and magnetic memory devices. They described developments observed during their recent association with Bell Laboratories, and pointed out how these developments will make available improved telephone systems deemed necessary to meet the continuing need for more and better telephone service at less cost. *Above, right:* Newly elected officers of the Columbus Section, *(left to right)* G. R. Tamplin, vice-chairman; E. O. Wolden, chairman; W. Z. Gingrich, recording secretary; and F. W. Atkinson, chairman of the newly organized Newark, Ohio, Subsection, discuss direct distance dialing plans of the Ohio Bell Telephone Company at a recent Section meeting.

Chicago and a luncheon at the South Shore Country Club complete with entertainment. Highlighting the social activity will be the Fall Frolics with a program expected to surpass previous years. Tickets for the Fall Frolics will be $12.50 per person.

"Is Engineering Study Being Discouraged?"—EJC Report

Engineers Joint Council (EJC) reports in *Engineer* that, faced with a national decline of 11.1% in Freshman engineering enrollment in 1958, the Engineering Manpower Commission (EMC) conducted a survey of 223 college deans to determine the causes. Some 173 deans responded; the majority cited principal reasons as: "False appraisal of long-range engineering career opportunities"; "Increased concern about rigors of engineering curriculum": "Increased interest by potential engineering students in other scientific fields."

The full 17-page report is available from EJC, 29 W. 39th St., New York 18, N. Y., at no charge.

Conference on Electrical Engineering Education

A weekend Conference on Electrical Engineering Education, the third in a series of such annual meetings sponsored by the electrical engineering department of Syracuse University, was held during June.

This series of conferences, held at Syracuse University's Sagamore Conference Center in the Adirondack Mountains, has participants consisting of nearly 100 electrical engineering educators in the northeastern United States and Canada.

In an atmosphere of informality, the conferees work and live together away from the pressures of normal activity for a 2-day period. The time is divided between presentation of a few selected papers related to the main theme of the Conference and informal discussions among small groups on common problems of education. Ample time is also provided for individual conversations and for recreation. The purpose is to bring together educators with common problems, to exchange experiences and ideas and to predict and plot the future course of electrical engineering education.

This year, the Conference was concerned with the changing role of the laboratory in undergraduate electrical engineering education, a topic of deep concern to educators at this time. The ever-expanding frontiers in electrical technology has put an increasing burden upon the electrical engineering educator to anticipate new technology by broadening the base of education in the area of engineering science at the expense of less activity in the study of present-day technology which might be headed for early obsolescence. The role of laboratory work at the undergraduate level in this atmosphere of change becomes much more difficult to assess. However, attempts were made at this Conference to define adequate laboratory programs.

Featured speakers were: Dr. W. L. Everitt, dean of engineering, University of Illinois, who in the keynote address summarized both progress and problems in some generality; Dr. Carl Volz, associate professor of electrical engineering, Pennsylvania State University, who described the use of the laboratory to teach fundamental concepts directly as opposed to its use merely to demonstrate and verify ideas learned in the classroom; Dr. Everand Williams, chairman of the department of electrical engineering, Carnegie Institute of Technology, who described the use of individual student projects to replace the more traditional forms of laboratory experiments and tests; Dr. H. H. Woodsen, Massachusetts Institute of Technology (MIT), who reported on the present status of MIT's new program in energy conversion and the development of the "generalized machine" as a laboratory tool, and Dr. T. F. Jones, Jr., chairman of the department of electrical engineering, Purdue University, who described the increasing importance of the computer as a basic tool in undergraduate instruction.

The Conference brought out the idea that the most significant trend in the laboratory portion of undergraduate instruction was in various attempts to increase the participation of the individual student in the planning and organization of his own laboratory work rather than the mere performance of stereotyped experiments by following a specific set of instructions. The use of the project type of laboratory, where the student is presented with an engineering problem to solve involving the use of experiment, and where he has the responsibility of

planning his own work, is finding increasing favor. The economic questions that such programs raised, relating to the need for more student equipment and more individual faculty counseling, were not specifically answered.

The Conference ended on a note of optimism for the future. Many ideas were carried by the participants back to their own institutions which will undoubtedly have great influence on the future course of electrical engineering education.

A grant from the National Science Foundation made the Conference possible, and the Professional Group on Education of the Institute of Radio Engineers will publish the Proceedings of the Conference.

New Officers for Illinois Valley Section

The Annual Dinner Meeting and Installation of Officers of the Illinois Valley Section of AIEE was held Thursday, May 7, 1959, in the new Bradley Student Center on the Bradley University Campus.

R. P. Johnson of Peoria, Ill., superintendent of electrical maintenance at Central Illinois Light Company was installed as the new chairman of the Section. Other new officers include J. G. Winnette, vice-chairman; F. L. Jones, secretary; and O. P. Wiltz, treasurer.

Principal speaker at the meeting was E. D. Stoetzel, executive secretary of the Peoria Manufacturers Association, who spoke on "The Erosion of Our Constitutional Liberties." Mr. Stoetzel explained how constitutional liberties are being jeopardized by such things as Government subsidies, Supreme Court rulings, Government control of personal income, and the action of special-interest groups. He then pointed out the action to be taken by private citizens to halt this erosion of our liberties.

Results of District Student Paper Competition

The names of the winners for the District Student Prize Papers Competition have been received at Headquarters.

In addition to the $25 Institute award to each first prize winner in the District, the Members-for-Life Fund has provided additional prizes which include a trip to the Summer General Meeting for the first prize winners, $25 for second prize, and $15 for third prize.

The students listed are the recipients of these awards.

District No. 1

1. D. M. Davies, R. L. Allen, co-authors, Clarkson College of Technology, "A Transistorized Pulse Monitor"
2. R. J. Lutz, Cornell University, "The Measurement of Minimum Perceptible Changes in Sound"
3. Tied between: Christopher Smith, Union College, "Cryogenics"; W. A. Hessinger, University of Buffalo, "The Voltage-Variable Capacitor"

SHOWN AT THE Annual Dinner Meeting and Installation of Officers of the AIEE Illinois Valley Section are *(left to right)*: C. E. Crawford, retiring Section chairman, and incoming officers: O. P. Wiltz, treasurer; F. L. Jones, secretary; and R. P. Johnson, chairman. Courtesy Peoria Journal Star

District No. 2

1. I. E. Sutherland, Carnegie Institute of Technology, "Stability in Steering Control"
2. R. W. Watson, Princeton University, "LAD—A Machine That Learns"
3. G. C. Riddle, Pennsylvania State University, "A New Color Television Camera System"

District No. 3

1. Robert Sommer, New York University, "A Narrow Bank Peak Clipping Speech Amplifier"
2. T. E. Browne, Manhattan College, "Counting Simultaneous Events"
3. David Friedman, Polytechnic Institute of Brooklyn, "The Transconductance Characteristic of a Germanium Alloy-Function Power Transistor"

District No. 4

1. W. E. Montgomery, Duke University, "Design and Construction of a Solid-State Video Pickup"
2. T. F. McIntosh, North Carolina State College, "Wide Signal Discriminator for Pulse Selection in Missile Guidance Systems"
3. Neil Lesser, Georgia Institute of Technology, "An Alpha-Numeric Punched-Card Reader"

District No. 5

1. R. G. Buus, University of North Dakota, "Rectifying PN Junction in Germanium"
2. I. L. McKittrick, University of Illinois, "Printed Circuit Techniques"
3. H. E. Rueckel, Northwestern University, "Device for Measuring the Velocity of Sound through Solids"

District No. 6

1. Robert Allington, University of Nebraska, "A Telemetering System for Stomach Pressure of Animals"
2. Baard Thue, South Dakota School of Mines and Technology, "Characteristics of a Discontinuous Temperature Control System"
3. F. H. Shaver, University of Wyoming, "The Human Operator as a Link in a Feedback Control System"

District No. 7

1. R. M. Goldwyn, Rice Institute, "The Bucking Broncho Motor as a Nonlinear Oscillator"
2. A. Poularikas, University of Arkansas, "New Shape Fission Counter for the University of Arkansas Accelerator"
3. J. W. Planinac, Oklahoma State University, "Earth Satellite Tracking Methods"

District No. 8

1. F. A. Spelman, Stanford University, "A Voltage Comparator for Low Frequency Noise Measurements"
2. B. H. Walton, California Polytechnic Institute, "The Design and Construction of a Transistor Selective Amplifier for Synchronizing a Tape Recorder and 35 mm Slide Projector"
3. Charles Blankenship, University of Arizona, "A Transistorized D-C Amplifier"

District No. 9

1. G. F. Miner, University of Utah, "A New Type Vacuum Tube Tester"
2. Gary Pearson, Oregon State College "Light Intensity Approach to Corona Research"
3. Timothy O'Keefe, University of Washington, "Thermoelectric Power Plants for the Northwest Power Pool"

District No. 10 (No Contest)

District No. 11

1. R. W. Hall, University of Toledo, "Design of Apparatus To Remotely Handle Radioactive Material"
2. M. D. VerSchure, University of Michigan, "Parametric Amplifiers"
3. R. P. Witman, Case Institute of Technology, "The Principles of the Phase Switching Interferometer"

District No. 12

1. J. J. Panico, Northeastern University, "Thermal Resistance and Its Measurement"

District No. 11 Student Paper Contest

Photographed by Fred Tambling Studio

PROF. ROBERT SCHINDLER *(left)*, Penn College, chairman of Student Activities for AIEE District No. 11, presents awards to student paper contest winners: *(left to right)* R. W. Hall, University of Toledo, first place, for his paper entitled "Design of Apparatus To Remotely Handle Radioactive Materials"; M. D. VerSchure, University of Michigan, second place, "Parametric Amplifiers"; R. P. Witman, Case Institute of Technology, third place, "The Principles of the Phase-Switching Interferometer." Other papers presented were: "Magneto-Hydrodynamics," Arno Nice, Penn College; "Electroluminescence," K. H. Thompson, University of Akron; "A 5-Megacycle Square Wave Generator," J. M. Walter, University of Cincinnati; "An Automotive Voltage Regulator," D. R. Hickey, University of Detroit.

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2. G. R. DeVerry, University of Massachusetts, " Electromagnetic Pumps: Theory and Operation"
3. Vinod Sundra, Massachusetts Institute of Technology, "An Automatic Telephone Dialing Device"

District No. 13

1. W. W. Clements, University of Alabama, "A Short-Range One-Way Communication System"
2. Tied between: J. L. Grissom, Tennessee Polytechnic Institute, "A Different Approach to the Problem of Automobile Ignition"; E. M. Stokely, Mississippi State University, "Reactance Amplifiers"

Student Engineers Compete for First Walter B. Morton Award

Engineering students from Bucknell University, Lehigh University, and Lafayette College delivered technical papers at Bucknell University the afternoon of April 10, 1959, to compete in the first annual Walter B. Morton Student Paper Contest. The Walter B. Morton Award for the best Student Paper in the Lehigh Valley Section of the AIEE was established in 1959 by a gift for that purpose from C. S. Brangan, president of the Bra-Bon Electric Company, Inc., of Philadelphia, Pa. Mr. Brangan and the late Walter B. Morton were close friends and were both active in AIEE affairs, particularly in Student Activities. Mr. Morton, who was vice-president of AIEE for District No. 2 in 1954-55, was associated with the Pennsylvania Power & Light Company.

There was keen competition for the first prize of $100 and an inscribed plaque to be held each year by the college or university represented by the winning student.

The first prize and the plaque were awarded to D. L. Talhelm of Lehigh University for his paper entitled "Signal Flow Graph" which dealt with a topological method for representing a system of linial equations. Second prize was awarded to J. E. Murphy and R. N. Ziegler of Lehigh University for their paper entitled, "Design of an Automatic Bowling Scorer." These men had actually built the scorer which could be used as an individual or team scorer. Third prize was awarded to P. K. Hart of Lafayette College for his paper entitled, "An All Triode Audio Power Amplifier." Other participants, their schools, and paper titles are as follows: T. McLaughlin, Bucknell University, "Multiplex FM Transmission"; R. E. Ward, Lafayette College, "The Maser" (Micro wave amplification by use of molecular rather than electronic processes); M. L. Frankel, Bucknell University, "Dial Telephony."

Following the Student Paper Contest and dinner in the Bucknell University cafeteria, the regular monthly meeting of the AIEE Lehigh Valley Section was held in the engineering building. The speaker was Dr. G. A. Inland, professor of electrical engineering at Bucknell University, who spoke on "The Analog Computer and a Demonstration of Its Engineering Application." Dr. Inland explained the theory and operation of the analog computer and presented a comparison of analog and digital computers. He discussed the application of these computers to electrical and mechanical engineering problems. As a part of the presentation, both an analog computer and the analyzation of a physical system were demonstrated.

Photographed by John G. Pitkin

AMONG the winners at the joint AIEE-IRE Student Prize Paper Contest were *(left to right)*: T. E. Browne, Manhattan College, fourth place; Robert Sommer, New York University, first place; Robert Schiller, Manhattan College, second place.

District No. 3 Prize Paper Contest

Over 150 students attended the 5th annual Student Prize Paper Contest sponsored jointly by AIEE District No. 3 and the Institute of Radio Engineers (IRE) Region No. 2 on April 24, 1959, at Stevens Institute of Technology. Robert Sommer of New York University (Day Division) brought top honors to his school with his paper "A Narrow Band Peak Clipping Speech Amplifier."

The second prize went to Robert Schiller of Manhattan College for his paper "Symbolic Analysis and Logical Design of Cryotron Circuits." Third prize was taken by David Friedman of Polytechnic Institute of Brooklyn (Day Division) for his paper "The Transconductance Characteristics of a Germanium Alloy–Junction Power Transistor." T. E. Browne of Manhattan College received fourth prize for his paper "Counting Simultaneous Events."

Through the generous co-operation of the New York Sections of AIEE and IRE, Mr. Sommer's prize is a $500 scholarship for graduate study. The other three prizes were in cash in the amounts of $100, $50, and $25, respectively.

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New York 18, N.Y.

Petroleum Industry Conference
Long Beach, Calif., August 23-26

THE ANNUAL Electrical Conference of the Petroleum Industry provides electrical engineers with invaluable training in recent developments and progress in the industry—training that is not available from any other source.

The 1959 Conference, with the theme of "Electromation," aims to broaden and further implement this group of highly specialized engineers. Papers on developments and applications in the production, refining, and transportation fields will provide a healthy interchange of electrical technology.

The Conference will be keynoted by broad top-management views of three groups vital to the progress in the petroleum industry–a major oil company, a major manufacturer, and a major utility. They will show the need for further electromation.

The Conference is open to members and nonmembers of AIEE.

Ladies Program

Desk and Derrick Club, Long Beach Chapter, Hostess

Monday, August 24

10:00 a.m. Coffee and Rolls—Garden Room, Second Floor

12:30 p.m. General Luncheon—$3.00

6:30 p.m. Disneyland—$2.50, Transportation Only (Children Welcome)

Tuesday, August 25

10:00 a.m. Knott's Berry Farm and Ghost Town—$2.50, Transportation Only (Children Welcome)

7:00 p.m. Social Hour and Banquet—$8.00

Wednesday, August 26

10:00 a.m. Pacific Coast Club (Children Welcome); Buffet Luncheon, Optional

Technical Program

The tentative technical program for the Conference follows.

Monday, August 24

8:00 a.m. Registration—Lobby

9:30 a.m. General Session—Pageant Room, Second Floor

Opening Remarks: Conference Chairman L. W. Swanson

Invocation: Mr. Clinton Neyman

Welcome: Hon. R. C. Kealer, mayor, Long Beach

Address: J. H. Foote, president, AIEE

Keynote Speakers:

A. F. Vinson, vice-president and group executive, General Electric Company, "Electromation in the Petroleum Industry—The Manufacturer's Role"

J. F. Davenport, executive vice-president, Southern California Edison Company, "Electromation in the Petroleum Industry—The Electric Utility Role"

12:30 p.m. General Luncheon—Pageant Room, Second Floor

Petroleum Industry Committee Chairman H. M. Stewart

Speaker: K. E. Kingman, director and senior vice-president, Union Oil Company, "Electromation in the Petroleum Industry—Present and Future"

2:30 p.m. General Session—Pageant Room, Second Floor

Petroleum Industry Committee Chairman H. M. Stewart

CP59-5010 Industrial Computers for Tank Farm Inventory—Control and Data Handling. *E. B. Turner,* General Electric Company

CP59-5002 Application of Accepted Cable-Heating Principles to Unequally Loaded Underground Duct. *R. D. Chamlee, D. E. McCall,* C. F. Braun & Co.

CP59-5011 Sparking of A-C Motor Rotors and Its Effect on Division 2 Applications. *C. R. Olson, E. F. Merrill,* Westinghouse Electric Corporation

7:00 p.m. Disneyland Trip

Tuesday, August 25

7:30 a.m. Author's Breakfast—Garden Room, Second Floor

8:00 a.m. Registration—Lobby

9:00 a.m. Refining—Pageant Room, Second Floor

L. B. Eddy, presiding

CP59-5012 Electrical Design Highlights—Irving Refinery. *J. L. Cunningham,* Standard Oil Co. of California

CP59-5013 Power Distribution to Refinery Process Units. *W. H. Dickinson,* Esso Research and Engineering Company

CP59-5014 Selection of Major Drivers for Refinery and Petrochemical Installations. *W. B. Wilson, I. H. Landes,* General Electric Company

9:00 a.m. Transportation—Empire Room, First Floor

C. D. Catt, presiding

CP59-5015 Union Oil's Supertanker Facilities. *Leonard Jones,* Union Oil Company

CP59-5016 The Future Place of Computers in Pipeline Control. *John Manry,* Tennessee Gas Transmission Company

CP59-5017 The Application of Large Synchronous Motors to Gas Transmission Systems. *M. A. Hyde, D. C. Washburn,* Westinghouse Electric Corporation

CP59-5018 A Solid-State Supervisory System. *George Beck,* Continental Pipeline Company

9:00 a.m. Production—Western Room, First Floor

C. H. Eckel, presiding

CP59-5019 Analysis of Drilling Rig Loads and Their Characteristics. *O. J. Graham, H. H. Hennell,* General Electric Company

CP59-5020 An All Electric Installation for West Coast's First Off-Shore Platform. *R. B. Pearce,* Standard Oil Co. of California

CP59-5021 Polyethylene Submarine Cables for Off-Shore Oil Rigs. *C. S. Roach,* Simplex Wire and Cable Co.

CP59-5022 D-C Electric Drilling Rigs Application and Operation. *E. E. Hogwood,* Westinghouse Electric Corporation. (Transactions Paper re-presented for discussion)

1:30 p.m. Refining and Transportation Field Trip

1. Four Corners Pipeline Termination and Control Center
2. Southern Pacic Pipeline Control Center
3. Richfield Refinery
4. Union Oil Supertanker Facilities
5. Subsidence Repressurization Station

1:30 p.m. Production Field Trip

1. Monterey-Texas Off-Shore
2. Huntington Beach Field
3. Shell Oil Automatic Production Field, Brea Canyon
4. Signal Hill Field

7:00 p.m. Social Hour—Terrace Room S, Second Floor

7:45 p.m. Banquet—Pageant Room, Second Floor

Wednesday, August 26

7:30 a.m. Author's Breakfast—Garden Room, Second Floor

AIEE Spokane Section Officers

L. C. FORD, outgoing chairman of the Spokane Section of the Institute, passes the gavel to W. A. Morgan, who is the newly elected chairman of the Section for the year 1959-60. Shown at the ceremony are (left to right): Prof. H. E. Hattrup, secretary-treasurer; Mr. Ford; Mr. Morgan; J. F. Eyrich, vice-chairman; and J. M. Nelson, AIEE vice-president for District No. 9.

9:00 a.m. General Session

M. A. Hyde, vice-chairman, Petroleum Industry Committee, presiding

CP59-5023 A User Views New Developments in Motor Insulation. *R. W. Mills,* Standard Oil Co. of Ohio

Panel Discussion on Motor Insulation

Moderator: L. B. Eddy, Universal Oil Products Co.

Panel: S. A. Axe, Atlantic Refining Co.
M. N. Halderson, Phillips Petroleum Co.
G. L. Moses, Westinghouse Electric Corporation
R. V. Shepherd, General Electric Company
V. B. Honsinger, Allis-Chalmers Manufacturing Company
J. S. Askey, Elliott Co.

2:00 p.m. Refining—Pageant Room, Second Floor

G. H. St. Onge, vice-chairman, presiding

CP59-5024 Remote Control of Refinery Tank Farm Equipment. *E. G. Warren,* Humble Oil & Refining Co.

CP59-5025 The Terminating and Splicing of Polyethylene Insulated Power Cable. *L. M. Roth,* Union Carbide Chemicals Co.; *S. Richards, R. F. Valois,* Union Carbide and Plastics Co.

CP59-5026 Experience with Overhead vs Underground Cables in Refineries. *T. R. Shaw,* Phillips Petroleum Co.

2:00 p.m. Transportation—Empire Room, First Floor

C. D. Catt, chairman, presiding

CP59-5027 Automatic Control of Oleum Pipeline Operation. *E. W. Messinger, Jr.,* Union Oil Co. of California.

CP59-5028 Controlling Pipeline Stations with Eddy Current Couplings. *E. C. Michels,* Continental Pipeline Co.

CP59-5029 An Electrical Power System for Unattended Remote-Controlled Gas Compressor Stations. *R. W. Smith, Jr.* Gulf Interstate Company.

2:00 p.m. Production—Western Room, First Floor

W. E. Withers, vice-chairman, presiding

CP59-5030 Electric Controls for an Off-Shore Lease Automatic Custody Transfer Unit. *J. W. Johnson,* Sun Oil Co.

CP59-5031 Protection of A-C Motors. *J. K. Howell, J. J. Courtin, L. V. Eidson,* Westinghouse Electric Corporation.

CP59-5032 Design Considerations in the Application of High-Temperature Motors for Oil Well Pumping. *J. H. Day, B. W. Bradbury,* General Electric Company.

CP59-5033 Barge-Mounted 15,000-Kw Gas Turbine Generator Plant. *S. P. Stone,* Creole Petroleum Corp.

6:00 p.m. Petroleum Industry Committee Dinner Meeting—Garden Room, Second Floor

8:00 p.m. Subcommittee Meetings

Refining—Garden Room, Second Floor
Transportation—Empire Room, First Floor
Production—Western Room, First Floor

Registration

A registration card addressed to the Wilton Hotel will be enclosed with the mailed announcement. If members desire a motel reservation, requests should be mailed to the Wilton Hotel, Attention Larry Lennon. Also enclosed is a card on which members may indicate those social functions and trips they wish to attend. This will be of great help to the committee making final arrangements. Members are requested to return both cards as soon as possible, not later than August 10.

A list of prices follows:

Registration	
AIEE Members	$ 7.00
Nonmembers	$10.00
Ladies and Students	no charge
Monday General Luncheon	$ 3.00
Tuesday Banquet	$ 8.00
Inspection Trips	
Production	$ 3.50
Refining and Transportation	$ 2.00
Tours, Transportation Only	
Disneyland	$ 2.50
Knott's Berry Farm	$ 2.50

Transportation

For those traveling by air: if the flight stops at Long Beach Airport, it is suggested that members deplane there as it is only 10 minutes by bus to the Hotel. If members deplane at Los Angeles International Airport, there is a direct bus service to the Wilton Hotel. Be sure to take the Long Beach bus (not the Los Angeles bus). For drivers there are ample parking facilities in the vicinity of the Hotel.

AIEE Committees

Petroleum Industry Committee: H. M. Stewart, chairman, Humble Oil and Refining Company, Baytown, Texas; M. A. Hyde, vice-chairman, Westinghouse Electric Corporation, East Pittsburgh, Pa.; T. V. Bockman, secretary, Plantation Pipe Line Company, Atlanta, Ga.

Subcommittee Chairmen: C. H. Eckel, Production, Humble Oil and Refining Company, Houston Texas; C. D. Catt, Transportation, El Paso Natural Gas Company, El Paso, Texas; L. B. Eddy, Refining, Universal Oil Products Company, Des Plaines, Ill.

Subcommittee Vice-Chairmen: G. H.

Technical Periodicals

The technical periodicals, *Communication and Electronics, Applications and Industry,* and *Power Apparatus and Systems* contain the formally reviewed and approved numbered papers presented at General and District meetings and conferences. The publications are on an annual subscription basis issued six times a year. Members may receive one subscription to any *one* of the technical periodicals for $2.50. The balance of the annual $5.00 subscription price will be paid by application of his annual dues for the year of the subscription. (Members may not reduce the amount of their dues payment by reason of nonsubscription.) Additional member subscriptions will be at the rate of $5.00. Nonmembers may subscribe on an advance annual subscription basis of $8.00 each (plus 50¢ extra for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.50 each. Discounts are allowed to libraries, publishers, and subscription agencies.

St. Unge, Refining, Esso Research and Engineering Company, Linden, N. J.; W. E. Withers, Production, Sun Oil Company, Beaumont, Texas; and J. J. Sonnier, Transportation, Shell Pipeline Co., Houston, Texas.

AIEE Headquarters Representative: R. S. Gardner, assistant secretary, technical activities, New York, N. Y.

Long Beach Conference Executive Committee: L. W. Swanson, chairman, C. F. Braun & Co., Alhambra, Calif.; L. D. Dame, vice-chairman, technical program, Southern California Edison Company, Los Angeles, Calif.; F. M. Dorey, vice-chairman, arrangements, General Electric Company, Los Angeles, Calif.; D. E. Steele, vice-chairman, budget, Allis-Chalmers Manufacturing Company, Los Angeles, Calif.; H. L. White, vice-chairman, publicity, Crouse-Hinds Company, Los Angeles, Calif.

AIEE FELLOWS ELECTED

***William Chappell Downing, Jr.** (M '35), assistant chief engineer, Sangamo Electric Company, Springfield, Ill., has been transferred to the grade of Fellow in the AIEE ". . . for contributions to development of the thermal converter, particularly for demand metering, totalization and load control." Mr. Downing was born December 6, 1902, in Terre Haute, Ind. He received a B.S. degree from Sheffield Scientific School, Yale University, in 1924. He served on the faculty at Yale as instructor, engineering mechanics and electrical engineering, from 1924 to 1927. He joined Sangamo Electric Company in 1927, taking charge of the development of Lincoln thermal demand meters in 1929. He was chief engineer and, later, vice-president of the Lincoln Meter Company, a subsidiary company, until it was absorbed by Sangamo Electric Company in 1940. He was active in the design and manufacture of Sonar equipment during World War II, returning to the demand metering field in 1946 as executive engineer. He was appointed assistant chief engineer in charge of thermal devices and of transformers in 1954. Mr. Downing is a member of Sigma Xi and Tau Beta Pi. He is a member of American Standards Association Section Committee C12, National Electrical Manufacturers Association Technical Committees on Watthour Meters and on Instrument Transformers, and AIEE Project Subcommittee on Instrument Transformer Test Code. Mr. Downing holds several patents on thermal demand meters and thermal converters.

W. C. Downing

*Mr. Downing's transfer to the grade of Fellow was approved at the Board of Directors meeting on April 23, 1959.

AIEE PERSONALITIES

W. D. Albright (AM '41, M '47), fellow engineer, power transformer department, Westinghouse Electric Corporation, Sharon, Pa., has received a $5,000 suggestion award. Mr. Albright's suggestion dealt with a more complete utilization of the electrical steel used in the manufacture of transformers.

R. A. Arrison (AM '50), has been elected vice-president for engineering of the Keleket X-Ray Corporation, Tracerlab's X-ray subsidiary. Mr. Arrison became Keleket's chief engineer in 1956. He served on the AIEE Electrical Techniques in Medicine and Biology Committee (1957-58).

R. D. Brown (AM '50, M '57) has transferred as sales representative for the Spokane (Wash.) district to the Washington, D.C., district of Allis-Chalmers Industries Group.

Henri Busignies (M '56, F '59), president of ITT Laboratories, Nutley, N. J., research division of International Telephone and Telegraph Corporation, received a 1959 Pioneer Award at the National Aeronautical Electronics Conference in Dayton, Ohio. Mr. Busignies was honored by the Professional Group on Aeronautical and Navigational Electronics for outstanding work in the development of automatic radio direction finders for aircraft.

W. L. Cisler (M '35, F '47), president and director of The Detroit Edison Company, has been named winner of the Goethals Medal for 1958, awarded by the The Society of American Military Engineers. This award was made to Mr. Cisler, who, serving as a consultant to the State and Defense Departments, the Atomic Energy Commission, the Mutual Security Agency, and the Economic Co-operation, Foreign Operations, and International Co-operation Administrations since World War II, took a principal part in the study and design of an interconnected transmission system for electric power in Europe and the Scandinavian countries. Mr. Cisler has served on the following AIEE Committees: Power Generation (1935-43, chairman 1940-42); Technical Program (1940-42); Standards (1941-42); Management (1947-54, chairman 1948-49); Professional Group Coordinating (1948-49); and Edison Medal (1956-61).

E. A. Walker (AM '34, F '47), president of the Pennsylvania State University, has been named winner of the Bliss Medal for 1958 by The Society of American Military Engineers. The citation reads in part ". . . Thus, by his inspiring personal participation and leadership in the military educational programs at the University and the planning for their continuing growth in both magnitude and quality, Dr Walker has made outstanding contributions to military engineering education and to the recognition of the importance of technical leadership in the National Defense establishment." Dr. Walker has served on the following AIEE Committees: Membership (1942-43); Education (1945-58, chairman 1956-58); Research (1947-51); Charles LeGeyt Fortescue Fellowship (1952-55, chairman (1954-55); Technical Operations Department (1956-58); Professional Development and Recognition Department (1956-58); Recognition Awards (1957-58).

O. P. Cleaver (AM '36, M '48) recently received his 7th "Outstanding Performance" rating at the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va. In addition to his 7th "Outstanding," a record for the Laboratories, he also received his second $300 "Sustained Superior Performance" award. Mr. Cleaver has been with the Laboratories in a military and civilian capacity since August 1942, and is presently chief of the electrical engineering department. He was a member of the AIEE Production and Application of Light Committee (1940-42).

L. R. Crane (AM '41 M '48), sales manager, Penn-Union Electric Corporation, has been appointed vice-president, sales. Mr. Crane joined the company in 1958 after serving as headquarters distribution sales manager of Anderson Electric Corporation.

W. L. Donaldson (AM '40, M '48), manager of communications research, Southwest Research Institute (SwRI), San Antonio, Texas, has been named chairman of the department of electrical engineering at SwRI.

P. B. Garrett (AM '24, F '49) will now serve as publisher as well as editor-in-chief of *Electric Light and Power*, Haywood Publication Company, Chicago, Ill. He has been editor of the magazine since 1945, before which he was associated with the Westinghouse Electric Corporation. A registered professional engineer in the State of Illinois, Mr. Garrett has been a

member of the following Institute Committees: Publication (1947-53), Research (1955-59), and Public Relations (1957-59).

Wilfred Henschel (AM '40, M '55), has resigned from the engineering department of the Port of New York Authority and has opened offices as an electrical consultant for consulting and design services on electrical installations for tunnels, bridges, airports, highways, industrial plants, warehouses, and commercial and institutional buildings.

G. W. Johnson (AM '51) has been appointed senior engineer, Space Guidance and Control Systems, International Business Machines Corporation, Owego, N. Y. He was formerly advisory engineer in Space Guidance and Control Systems.

D. D. Israel (F '48), executive vice-president of Emerson Radio & Phonograph Corporation, Jersey City, N. J., addressed the June 4th session of the 3rd National Conference of the Institute of Radio Engineers Professional Group on Production Techniques, held in San Mateo, Calif. The subject of Mr. Israel's talk was "Printed Circuits in High Volume Electronic Equipments."

M. J. Kelly (M '26, F '31), who has been a member of the Bausch & Lomb Optical Company's board of directors since 1956, will also serve in a consulting capacity to the company. Dr. Kelly retired as chairman of the board of Bell Telephone Laboratories, Inc., on March 1, 1959. He began his Bell System career in 1918. Dr. Kelly's achievements have been recognized by a number of medals and awards, including the 1954 Medal of the Industrial Research Institute, the 1955 Christopher Columbus International Communication Prize, the Air Force Exceptional Service Award and the Air Force Association Trophy, the 1958 James Forrestal Medal of the National Security Industrial Association, and the 1959 John Fritz Medal. Dr. Kelly has served on the following Institute Committees: Communication (1934-37); Standards (1934-39, 1941-43); Basic Sciences (1937-40); Lamme Medal (1940-43); Research (1940-45, 1947-51, chairman 1949-51); Award of Institute Prizes (1949-51); Technical Program (1949-50).

A. M. Killin (AM '41, M '49) has been appointed assistant to works manager of Union Carbide Metals Company, division of Union Carbide Corporation. Mr. Killin, who has been assistant manager of the Niagara Works of the company at Niagara Falls, N. Y., will transfer to the New York office. He served on the AIEE Industrial and Commercial Power Systems Committee (1956-59).

F. R. Lack (M '37, F '48), retired vice-president of Western Electric Company, was honored during the 35th annual convention of the Electronic Industries Association (EIA), when he received the 1958 EIA Medal of Honor for his outstanding contributions to the industry. During his career of almost half a century with Western Electric, Mr. Lack moved steadily through the ranks of the company from a tester in the special equipment shops in 1911 to a vice-president and member of the board of directors at his retirement in 1958. He served on the AIEE Communications Committee (1938-41).

D. C. Luce (AM '36, F '49) was re-elected president of Public Service Electric and Gas Company by the board of directors of the company at its organization meeting in Newark, N. J.

J. W. McNall (AM '38, M '47), assistant director of research, Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J., has been named director of research of the Lamp Division. Dr. McNall is a member of the American Physical Society and the Institute of Radio Engineers.

Raymond Mirrer (M '53) has been elected vice-president of Strato-Missiles, Inc., New York, N. Y. Mr. Mirrer is a registered professional engineer as well as a lawyer. He was recently installed as president of the Brooklyn Engineers' Club.

C. C. Nash (AM '33) division consultant, Electronics Division, Stewart-Warner Corporation, Chicago, Ill., has been appointed a senior scientist at Hoffman Electronics Corporation's new Science Center in Santa Barbara, Calif.

Ted Palmer (M '50), of S&C Electric Company, has been named manager of the Western Sales Division of the company. He will be responsible for 10 western states, including Alaska and Hawaii, and will supervise the Western Sales Division staff with headquarters in Burlingame, Calif.

R. L. Palmer (AM '39), manager of product development, Data Processing Division, International Business Machines Corporation, has been appointed assistant director for engineering on the staff of the vice-president, research and engineering.

J. G. Pearce (M '57) has been appointed assistant manager of the systems planning branch in the telecommunication engineering department of Stromberg-Carlson, a Division of General Dynamics Corporation. **R. L. Layburn** (M '58) becomes section manager of carrier and component development in the same department.

F. D. Reese (AM '46, M' 52), engineering director, General Telephone Service Corporation, New York, N. Y., has been appointed to the Standards Council of the American Standards Association (ASA). Mr. Reese will represent the ASA Telephone Group which is a member body. The Standards Council is responsible for all standards activities of the ASA and supervises the work of 13 standards boards and one advisory board. It determines over-all standards policy and approves American Standards. Mr. Reese has served on the AIEE Communication Switching Systems Committee (1955-59).

J. R. Shafto, Jr. (AM '57), has been assigned to the Allis-Chalmers Manufacturing Company's Norwood (Ohio) Works electrical department. Mr. Shafto recently completed Allis-Chalmers training course for graduate engineers.

M. R. Shaw (AM '40, M '46), applications engineer, electronic components department, Corning Glass Works, Corning, N. Y., has been named supervisor of product development. As manager of the newly formed product development department, Dr. Shaw will direct a program to select and evaluate new component concepts and products of potentially major importance. He served on the AIEE Electronics Committee (1949-51).

P. S. Shelton (AM '52, M '58), engineer for the Narragansett Electric Company, Providence, R. I., has been promoted to assistant district engineer for the Worcester County (Mass.) Electric Company with headquarters at Milford, Mass. Each of the aforementioned companies is a part of the New England Electric System of Boston, Mass. Mr. Shelton has been very active in the affairs of the Providence Section, having served on several of its committees.

R. M. Shoop (AM '45) has been elected vice-president and director of publicity by the board of directors of Multiamp Electronic Corporation, Union, N. J. Mr. Shoop served in various editorial capacities with McGraw-Hill Publishing Company, New York, N. Y., for 23 years.

Philip Sporn (AM '20, F '30, Member for Life), president of the American Electric Power Company, has been elected to the board of directors of the Atomic Industrial Forum, association of the atomic industry. Mr. Sporn's concurrent nuclear activities include membership on the Edison Electric Institute's Technical Appraisal Task Force on Nuclear Power and chairmanship of the Research and Development Committee of the East Central Nuclear Group, Inc. He is also a director and former president of Nuclear Power Group, Inc. Mr. Sporn has served on the following AIEE Committees: Transmission and Distribution (1927-28, 1929-47, chairman 1941-43); Research (1932-36); Production and Application of Light (1933-34); Power Generation (1933-39); Technical Program (1941-43); Standards (1941-43); Award of Institute Prizes (1942-43); Lamme Medal (1944-47); Edison Medal (1948-53).

R. C. Sprague (M '40, F '49), chairman of the board and treasurer of Sprague Electric Company, North Adams, Mass., received an honorary doctor of science degree from Lowell Technological Institute at their 61st annual commencement exercises on Sunday, June 14.

W. H. Stang (M '51) has retired as manager of Pennsylvania Power & Light Company's engineering services department after nearly 40 years of service with the company. Mr. Stang is a member of the Lehigh Valley Engineers Club.

Joseph Suarez (AM '49) has been appointed supervisor to co-ordinate development projects on automatic circuit and component testing devices at California Technical Industries Division of Textron,

Inc., Belmont, Calif. Mr. Suarez is a member of the AIEE Solid-State Devices Committee (1957-59).

B. R. Teare, Jr. (AM '29, F '42), dean of the College of Engineering and Science at the Carnegie Institute of Technology, has been chosen president of the American Society for Engineering Education (ASEE) for the year 1959-60. Dean Teare has been a member of the ASEE since 1933, when he joined the teaching staff at Yale University in electrical engineering. After earning bachelor's and master's degrees in electrical engineering at the University of Wisconsin (1927 and 1928), he served as test engineer for General Electric Company before returning to teaching and research in 1933. He received his doctor of engineering in electrical engineering at Yale in 1937. Dean Teare joined the staff of Carnegie Institute of Technology in 1939; he was head of the department of electrical engineering there from 1944-50 and dean of graduate studies from 1950-53. Dean Teare served as vice-president of the AIEE, 1957-59, and on the following Institute Committees: Communications (1934-36); Electrical Machinery (1937-42); Education (1941-58, chairman 1948-50); Professional Group Co-ordinating (1948-49); Technical Program (1948-50); Publication (1948-50); Edison Medal (1951-56); Professional Development and Recognition Department (1956-58).

R. D. Teasdale (AM '46, M '54) has been appointed head of the systems analysis department of Hughes Aircraft Company's Ground Systems Group. Before joining Hughes in 1958, Dr. Teasdale was on the engineering staff of Melpar, Inc., Falls Church, Va., and taught electrical engineering at several colleges.

A. E. Thiessen (M '41), vice-president and a director of General Radio Company, has been elected to the board of directors of Baird-Atomic, Inc. Mr. Thiessen is also a director of Black and Webster, Inc., Buff and Buff Manufacturing Co., and the Scientific Apparatus Makers Association.

A. C. Verock (AM '54), formerly in charge of Transmission Line Design Section, Commonwealth Associates, Inc., Jackson, Mich., has been appointed chief engineer, pole line hardware, Hubbard and Company, Chicago, Ill.

Ernst Weber (AM '31, F '34), president of the Polytechnic Institute of Brooklyn, received an honorary degree of doctor of engineering from Newark College of Engineering in recognition of his distinguished career as research scientist, electrical engineer, and educator and teacher at the Polytechnic Institute of Brooklyn, whose president he became in December 1957. A pioneer in high-frequency electronic research, Dr. Weber holds more than 50 American, Canadian, and British patents in the field of microwave techniques. He has served on the following AIEE Committees: Basic Sciences (1935-47); Research (1935-39); Charles LeGeyt Fortescue Fellowship (1942-48); Instruments and Measurements (1950-56, chairman 1955-56); Board of Examiners (1954-57); Science and Electronics Division (1955-58); Technical Operations Department (1956-58); Education (1956-58); Instrumentation Division (1956-58); Indicating and Integrating Instruments (1956-57); Special Instruments and Auxiliary Apparatus (1956-57); Electronic and High Frequency Instrumentation (1956-57).

The following members of the Institute were among those who received honorary life membership awards from the American Public Power Association: **O. E. Eckert** (M '35), general manager, Board of Water and Light, Lansing, Mich.; **S. B. Morris** (M '47, F '57), consultant and former general manager and chief engineer, Department of Water and Power, Los Angeles, Calif.; **J. F. Ward** (M '49), consulting engineer, Seattle, Wash., and formerly superintendent, Department of Lighting, Tacoma, Wash.; **R. L. Schacht** (AM '44, M '50), general manager, Consumers Public Power District, Columbus, Nebr.; **W. S. Peterson** (AM '23, F '46, Member for Life), general manager and chief engineer, Department of Water and Power, Los Angeles, Calif.; **O. W. Hurd** (AM '38, F '58), managing director, Washington Public Power Supply System, Kennewick, Wash.; **A. L. Pierce** (AM '02, M '12, Member for Life), formerly manager and chief electrical engineer for the Wallingford Plant, Borough Electric Works, Wallingford, Conn.; **G. E. Johnson** (AM '13, F '59), consultant, Central Nebraska Public Power and Irrigation District.

OBITUARIES

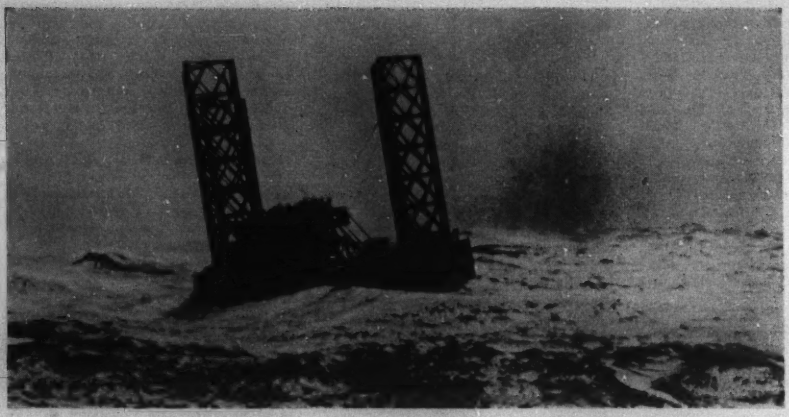
Clifford Hill Cramer (AM '27, M '34, F '53), electrical engineer, cable department, Western Union Telegraph Company, New York, N. Y., died recently at the age of 64. Mr. Cramer was born in Cramer, Pa., on August 24, 1895. He received the B.S. degree in E.E. from the University of Michigan in 1918. In 1919, he joined Western Union as an engineering assistant. He was named research group leader in 1921, assistant research engineer in 1934, and assistant transmission engineer in 1940. Mr. Cramer was a registered professional engineer in the State of New York and the author of several AIEE technical papers. He was known for his outstanding contributions to the ocean cable transmission arts and specifically for directing the development and design of electronic undersea repeaters. He had served as a member of the AIEE Communications Committee (1947-48) and Tele graph Systems Committee (1955-56).

Felix Stephen Glaza (M '46), consulting engineer, Texas Division, Dow Chemical Company, Freeport, Texas, died recently. Mr. Glaza was born July 1, 1902, in Bay City, Mich. He received the B.S. degree in E.E. from the University of Michigan in 1925. He joined the General Electric Company in 1925, after which he worked for The Detroit Edison Company, Packard Motor Car Company, and Ford Motor Company. He became associated with the Dow Chemical Company, Midland, Mich. in 1933, transferring to the Texas Division of the company in 1940. Mr. Glaza was very active in the Houston, Texas, Section of the Institute, and served on the following National AIEE Committees: Chemical, Electrochemical, and Electrothermal Applications (1947-59, chairman 1954-56); Industrial Power Systems (1948-57); Electronic Power Converters (1951-52); Industry Division (1954-59); Research (1956-59); and Professional Development and Recognition Department (1957-59).

Henry H. Kerr (AM '17, M '26, F '44, Member for Life), of Commonwealth Associates, Inc., Jackson, Mich., died recently. Mr. Kerr was born in Forth Worth, Texas. After graduation from the University of Colorado in 1914 with a B.S. degree in E.E., he spent one year in the test course of the General Electric Company, Schenectady, N. Y. Following this, he spent 14 years with the Public Service Company of Colorado and then transferred to Toledo, Ohio, as superintendent of the electrical operating department of the Toledo Edison Company. After his retirement from the company as a vice-president, he became associated with Commonwealth Associates, Inc., as a consulting engineer in connection with consulting and design engineering services for generating plants and operating systems. Mr. Kerr served as AIEE vice-president for District No. 11 (1956-58) and had been a member of the Electrical Machinery Committee (1942-46). He was a fellow of the American Society of Mechanical Engineers and a member of the Ohio Society of Professional Engineers, a past president of the Engineering Society of Toledo, and had been a member of several committees of the Association of Edison Illuminating Companies.

John Cromwell Lincoln (AM '07, M '12, F '32, Member for Life), founder of the Lincoln Electric Company, Cleveland, Ohio, died recently at the age of 92. Mr. Lincoln was born on a farm in Ohio on July 17, 1866. He graduated from Ohio State University in 1888, after which he joined the Brush Electric Company. In 1889, he was employed by the Short Electric Company, St. Louis. In 1892, he returned to Cleveland where he became associated with the Elliott Company. In 1893, Mr. Lincoln founded the Lincoln Electric Company. He served as president of the firm from 1906 to 1928, when he became chairman of the board. Many of the company's products were developed by Mr. Lincoln, who held more than 50 patents for electrical devices, including the variable speed motor. He was also a pioneer in the development of ductile welds. Mr. Lincoln was greatly interested in the economic theory of the single tax, about which he wrote numerous pamphlets and books. He was a member of the American Society of Mechanical Engineers, American Welding Society (AWS), Sigma Xi, and Tau Beta Pi. He received the Samuel Wylie memorial award from the AWS in 1934 for his contributions to the art of welding. Mr. Lincoln served on the following Institute Committees: Industrial and Domestic Power (1914-15); Electric Welding (1927-39, chairman 1927-28); and Meetings and Papers (1927-28).

OF CURRENT INTEREST



BLACK BEETLE off-shore platform rides out rough sea during its ocean voyage to drilling location off Sicily.

Offshore Oil-Well Drilling Platform Towed to Italian Site

A HUGE three-legged "self-elevating portable island" recently began drilling an offshore oil well 1¼ miles off the coast of Gela, Sicily, after making a rough 7,000-mile tow-voyage from the United States to the Mediterranean Sea. Part of the voyage was through 75-foot seas, according to the captain of the ocean tug *Zeeland* which handled the crossing. At one point, the 1,000-ton platform is reported to have ripped loose from the tug, but because of the platform's stability while afloat, it arrived without damage.

Designed and built by R. G. LeTourneau, Inc., Longview, Texas, at its marine facilities near Vicksburg, Miss., the platform was sold to SAIPEM, a subsidiary of the Italian Government's oil company, known as Enta Nazionale Idrocarburi (E.N.I.) Upon its arrival in Italy, the platform was outfitted with derrick and other equipment for the oil-drilling operations.

INBOARD gears are shown that connect electric motors to racks on legs of a platform.

Operating Features

The platform's triangular hull measures 120 feet by 115 feet, with a depth of 13 feet. Equipped for drilling to more than 10,000 feet, it has the ability to raise itself above the water at a rate of 1 foot per minute.

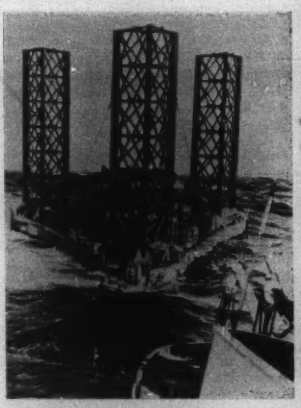
Most important feature of the platform is that it can be moved quickly and cheaply from one location to another after each well is drilled. Three electrically powered 120-foot legs raise and lower the platform. Tank-like "feet" provide stable footing on the floor of the sea. The unit operates with the assistance of a "tender," or supply vessel, anchored alongside.

The platform is basically a floating barge with electromechanically powered spuds or legs. With spuds retracted, it is towed to the drilling site where it lowers its legs to the bottom and then elevates its decks to the desired height above the ocean surface.

Raising and Lowering

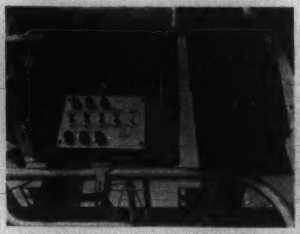
The platform is elevated by actuating electric motors, three to each leg or nine in all, turning the gears that engage the pinion rack on the side of each triangularly shaped leg structure. When the legs reach firm ground the hull rises above the water. The raising of the hull continues until it clears the surface by about 10 feet. If the platform is not level, each leg can be raised or lowered independently, allowing perfect leveling of the platform, and eliminating the need for leveling the derrick.

The interior compartments of the hull can be filled with water to apply a known weight to the legs before drilling begins. This preloading assures that the legs have

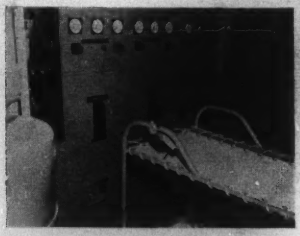


ENROUTE photograph of three-legged platform, built by R. G. LeTourneau, Inc., showing relatively calm period in platform's 7,000-mile tow voyage.

CONTROL PANEL raises and lowers the platform to desired water level.



SPEED control panel is shown here during construction at LeTourneau's marine facilities near Vicksburg, Miss.



PLATFORM'S main control panel is shown. Bunk was placed in generator and control shelter during ocean tow as emergency shelter for tug riding crew.

reached their maximum penetration of the soil. The water is then unloaded by means of a high-capacity centrifugal pump installed on the deck of the platform. The 440-volt a-c for operating the electric motors for the legs and pump is generated aboard the platform by two diesel engines connected to electric generators.

The electric motors develop 25 hp each. They operate the legs through a gear reduction train with a ratio of 6,000 to 1. After drilling operations are completed, the platform is lowered to the water, the spuds retracted, and the entire unit could then be towed to a new location, and the cycle repeated.

Among the equipment contained on the platform is the company's electric winch, designed specifically for marine applications. Its motor is powered by the ship's service current. When the motor is reversed for powered lowering, built-in regenerative electric braking automatically holds the load at a safe lowering speed. Brakes set instantly when power is off and release instantly when power is applied.

SPUD GEAR assembly of one of LeTourneau platforms.

Winch capacity is approximately 12 times its own weight.

Self-Contained Platforms

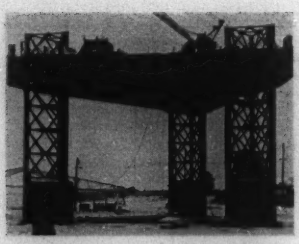
The company also builds self-contained platforms, as distinct from the tender-assisted platform heretofore described. These self-contained platforms carry all of the equipment necessary for drilling offshore, including mud pumps; pipe racks; cementing units; mud bins; full-revolving deck cranes; anchor winches; a heliport; and living facilities for a complete drilling crew which boast a stainless steel electric kitchen, air-conditioned sleeping quarters, and a combination dining-recreation area. An intercom network connects strategic points of the platform with the control office. Shortwave and a ship-to-shore radio telephone provides a complete communication service. From the control office above the upper-quarters deck, the engineer controls elevation and lowering operations.

DETAIL shot of a platform.

Capable of operating in water over 100 feet in depth and drilling to 20,000 feet, one such platform successfully withstood the full force of 1957's hurricane Audrey off Cameron, La.

A recorded performance by another of the platforms broke all relocation speed records. The platform was lowered to the water, moved 1 mile, and elevated to drilling height in 62 feet of water within a total elapsed time of 8½ hours.

The company has previously built eight mobile offshore platforms of varying sizes, operating in the Gulf of Mexico, Sea of Japan, and the Persian Gulf.



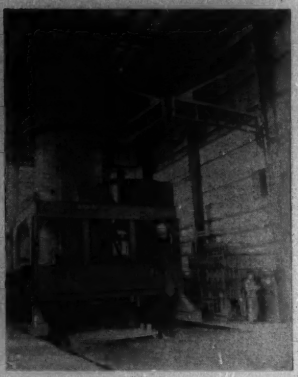
AFTER COMPLETION, the platform was walked into the river by elevating and lowering the deck on the electrically powered "legs," which can be manipulated individually, then readied for its ocean voyage.

Gantry Type Hardening Furnace Lined with Lightweight Insulation

INSULATING REFRACTORIES play an important part in a new gantry type controlled atmosphere hardening furnace with atmosphere quench for hardening rocket motor cases and aircraft components.

The new installation which went into operation at the Lindberg Steel Treating Company's Melrose Park Plant near Chicago, Ill., in March is a controlled atmosphere hardening furnace large enough to handle the rocket motor case of the Minuteman intercontinental ballistic missile (ICBM).

The hardening furnace and associated equipment can accommodate a loading fixture with an effective work load of 80 inches in diameter by 288 inches in length. It is electrically heated, has five control zones and operates between 250 F and 2,050 F. The furnace, which rolls on wheels along tracks that straddle a large pit, is both bottom loading and bottom quenching. The pit, which is 19 feet wide by 28 feet deep by 55 feet long, houses the loading station, atmosphere quench tank, salt quench tank, and water wash tank.



GANTRY TYPE controlled-atmosphere hardening furnace, lined with Armstrong *A-25*, with atmosphere quench for hardening rocket motor cases and aircraft components straddles large pit housing loading station, atmosphere quench tank, salt quench tank, and water wash tank at the Lindberg Steel Treating Company installation.

A 6,000 cubic feet per hour endothermic gas generator supplies atmosphere gas to the hardening furnace.

Insulating Slabs Used

The work chamber of the furnace is lined with a high-quality lightweight insulating refractory supplied by the Armstrong Cork Company through its distributor, Illinois A. P. Green Fire Brick Company of Chicago. This refractory is backed by courses of medium- and low-temperature insulating slabs.

Because of the exacting nature of the heat treating system, the insulating fire brick has the important function of helping keep temperatures constant.

The insulating fire brick selected for this job from Armstrong's line of refractories was type *A-25* which has a maximum hot-face temperature of 2,500 F. The *A-25* has a modulus of rupture of 110 pounds per square inch and compressive strength of 225 pounds per square inch. The Pyrometer Cone Equivalent is 29; the corresponding softening point 3,018 F.

The insulating fire brick used in Lindberg's new furnace is formulated to balance insulating efficiency with high strength. To make brick with these two properties in balance, Armstrong uses selected refractory clays blended with particles of carefully graded burn-out material. When the bricks are fired, the burn-out is consumed, leaving in the brick structure the scientifically sized air spaces that give these bricks high insulating value.

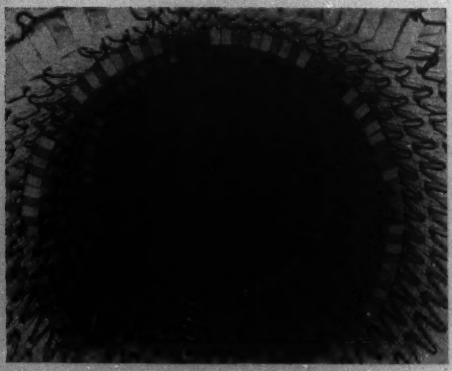
Close control of combustion when the bricks are fired eliminates internal strains and gives the bricks a uniform structure throughout. The high strength that results greatly lengthens the life of the bricks. They withstand mechanical abuse, offer great resistance to wear and to erosion by high velocity gases and flame impingement, have good load-bearing properties, and permit sound wall construction.

Strong Mortar Bond

They resist spalling, and the fine-grained, dust-free surface allows mortar to key securely for a strong bond. At 1,200 F mean temperature, *A-25* insulating fire bricks have a conductivity of 2.4 Btu per square foot–hour–degrees F per inch.

Nearly 10,000 nine-inch tailor-made wedge shaped *A-25* type bricks were used in lining Lindberg's controlled atmosphere hardening furnace which, with associated equipment, was designed to fulfill the most exacting heat treatment requirements of existing and future metals and provide reliability in reproducing these heat treatments. The insulating refractories used to line the furnace help provide these needs.

The work load is lifted into the furnace by a two-speed winch with a 42-foot alloy chain. Heating elements employed for temperatures up to 2,050 F are mounted in tiers in order to provide 500 kw in the five zones of control. The furnace rolls on wheels along tracks that straddle a large pit in which are housed the loading station, atmosphere quench tank, salt quench tank, and water wash tank. The heating elements are installed with metal hangers driven into the insulating refractories of the hardening furnace.



INSIDE VIEW of new controlled - atmosphere hardening furnace, looking from bottom to top. Large enough to accommodate rocket motor case of Minuteman ICBM, the Lindberg Steel Treating Company's Melrose Park Plant furnace is lined with Armstrong *A-25* insulating fire bricks which combine high strength with high insulating efficiency.

Contrasts in Lamp Design

The larger of the two lamps shown was designed to produce an intensely bright light of only 15 seconds' duration for use with an infrared tracking device used to trace the early flight of missiles. An intense concentrated light was required to chart the missile's course accurately. It burns brilliantly until the glass envelope melts and collapses in about ¼ of a minute. The smaller lamp, ⅛-inch in diameter and ¼-inch in over-all length, used in airplane instruments, is designed with a wide margin of reliability against voltage surges and vibration, and will burn continuously at the rated voltage for an infinite period calculated at 1 billion years. Both were engineered and designed by the Chicago Miniature Lamp Works.

Situation Indicator Gives Pilot "Skyway Signs"

An aircraft navigation instrument that serves the pilot in much the same manner highway signs serve a motorist is being produced for U. S. Air Force jets.

The instrument, called a Horizontal Situation Indicator (HSI), utilizes pointers and numerical dials to create an artificial sky highway complete with intersections, direction of travel, route number, deviation from the route, miles traveled, miles to travel, and the heading of the aircraft.

The instrument, produced by Collins Radio Company, Cedar Rapids, Iowa, is a major part of a new instrument panel system adopted by the Air Force. The HSI is a result of continuing development on Collins integrated flight director instruments now being used in several versions by the Air Force and civilian airline and business aircraft operators.

The Air Force HSI provides instrumentation for ground radar control, ground radio course following and interception, automatic direction finding, new defense control systems, airborne radar and other new navigational systems. It provides for tie-in with various automatic pilot systems to allow navigational monitoring of automatic flight. The type of operation selected by the pilot is also displayed on the instrument face to provide a continuous reference to the type of signals being used.

Electronic "Chauffeurs" Are Possibility on Tomorrow's Highways

AN AUTOMATIC HIGHWAY of the future, offering virtually full-time electronic chauffeur service, was unveiled in scale model recently by General Motors Research Laboratories.

Called Auto-Control, the system takes over steering, speed control, and obstacle detection. Adapted to Chicago-to-New York toll roads, for example, a driver would scarcely have to touch the steering wheel, accelerator, or brake until he reached the Lincoln Tunnel cutoff into Manhattan, except for fuel and rest stops.

Firebird III Exhibited

The company also exhibited its Firebird III, a highly styled gas-turbine car, and Hy-com (highway communicator), which automatically radios vocal information or trouble-ahead warnings from roadside to driver, either through the car radio or a separate receiver (*Electrical Engineering*, Feb. 1959, pp. 160-61.)

Firebird III already has automatic steering, which could be adapted to an Auto-Control highway, plus Unicontrol, a single "stick" for manually steering, accelerating, or braking the car when it travels over present-day roads.

Scale Model System

Thus, Auto-Control represents further refinements, in miniature, of electronics. In addition to automatic steering, a sensing device speeds up or slows down cars automatically, depending on traffic or obstacles ahead. Also provided are warning lights for manually guided cars whose drivers might use the automatic lane for passing. The lights would warn that an Auto-Control car is nearby in the automatic lane.

The exhibited system is a 1/40th scale model simulating a 4-lane divided highway. Four miniature buses, controlled by electrical signals from the road, roll around the 20- by 30-foot oval highway at either of two predetermined speeds that are equivalent to 30 and 60 mph on a full-size highway. All electronic units in the 11-inch long model-sized buses are full scale, as well as the master control units.

Auto-Control, it was stated, was built to stimulate both highway and automotive research interest in an automatic highway concept. Auto-Control is said to represent one workable approach to a very complex problem.

Auto-Control vehicles are steered by an electromagnetic system similar in principle to that on Firebird III. The Firebird can follow a "magnetic" path created by low-frequency electric current from a cable embedded in the road. An electronic computer takes the signals from the imbedded cable and actuates a servo system to steer the car.

CONTROLLED by electrical signals from the highway, these 11-inch model busses can accelerate, steer themselves at speeds equivalent to 60 mph on a full-sized highway, and stop whenever a vehicle ahead stops or any metallic object is placed in their path. Each of the busses, part of GM's model highway system called Auto-Control, is controlled by a package of full-sized electronics (lower right) which is not much larger than a transistorized radio.

Future Meetings of Other Societies

3rd National Heat Transfer Conference and Exhibit, joint ASME–AIChE, Aug 9-12, U of Conn, Storrs, Conn. D. A. Fischer, Mech Engg Dept U-37, U of Conn, Storrs, Conn.

AWS, 41st Annual Meeting & Welding Exposition, Apr 25-29, 1960, Los Angeles, Calif. *Deadline for Abstracts:* Aug 15, 1959. Send to: AWS, Dept P, 33 W 39 St, New York 18, N. Y.

Institute of Radio Engineers
1st National Ultrasonics Symposium, Aug 17, San Francisco, Calif. Vincent Salmon, Stanford Research Inst, Stanford, Calif.
WESCON, Aug 18-21, Cow Palace, San Francisco, Calif. WESCON HQ, 1435 LaCienega Blvd, Los Angeles, Calif.

Short Course in Thermochemistry of Rocket Propulsion, Aug 17-28, UCLA, Los Angeles, Calif. Engineering Extension, Engineering Bldg, Rm 3116, UCLA. Los Angeles, Calif.

National Council of State Boards of Enginering Examiners, 38th Annual Meeting, Aug 19-22, Hotel Roanoke, Roanoke, Va. NCSBEE, Palmetto State Life Bldg, PO drawer 1404, Columbia, S. C.

AIME, Conference on Semiconductors, Institute of Metals Div, Aug 31—Sept 2, Statler Hotel, Boston, Mass. H. N. Appleton, AIME, 29 W 39 St, New York 18, N. Y.

Association for Computing Machinery, 14th Annual Meeting. Sept 1-3, MIT, Cambridge, Mass. J. H. Wegstein, ACM Program Committee, NBS, Washington 25, D. C.

2nd Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, Sept 17-18, Western Union Auditorium, 60 Hudson St, New York, N. Y. Security clearance not required. B. Reich, Solid State Devices Branch, ECRD, U.S.A.S.R.D.I., Ft Monmouth, N. J.

Overseas

American National Exhibition, Aug 1–Sept 5, Sokolniki Park, Moscow, USSR.

International Conference on the Application of Large Radiation Sources in Industry, International Atomic Energy Agency, Sept 5-11, Warsaw, Poland. Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.

The Yugoslav Association for the Protection of Material, International Conference for Protection of Hydroelectric Power Plants and Equipment, Sept 14-16, Belgrade, Yugoslavia. Organizing Committee, above conference, Kneza Milosa St., No. 7/III. P.O. Box 771, Belgrade, Yugoslavia.

CIB Congress 1959, International Council for Building, Research Studies, and Documentation, Sept 21-25, Rotterdam, The Netherlands. Congress Secretariat, c/o Bouwcentrum, Postbox 299, Rotterdam, The Netherlands.

The Institute of Physics, Conference on Some Aspects of Magnetism, Sept 22-24, Sheffield, England. Conference Secretary, Inst of Physics, 47 Belgrave Sq, London, SW 1, England.

2nd Congress of the Société Française des Electriciens, Sept 24-27, Aix-les-Bains, France. Société Française des Electriciens, 10, Ave Pierre-Larousse, Malakoff (Seine), France.

Plastics 1959—International Trade Fair, Oct 17-25, Düsseldorf, W. Germany. Nordwestdeutsche Austellungs-Gesellschaft mbH (NOWEA), Düsseldorf, Ehrenhof 4, W. Germany.

MODEL BUSSES operate on a completely automatic model highway, developed at GM Research Labs. Explaining the 20- by 30-foot scale model to 5-year-old George Roberts is research engineer H. M. Morrison.

Measured Car Speeds

In the Auto-Control system, the guidance cable in the pavement is a crisscross wire in the center of the automatic lane, which also provides a means of measuring car speed. Another cable in the pavement provides a speed control signal; still other circuits regulate the speed of all automatic vehicles for safe spacing.

Obstacle detection is accomplished by dividing the highway into control sections or blocks—200 feet long on a full-size highway, 5 feet long on the Auto-Control model. When a car is in a particular block, its speed determines automatically the speed of vehicles in two blocks or sections behind it.

If a vehicle is stopped in the automatic lane, the following car is stopped in the first block to the rear and this chain reaction backs up along the highway as other vehicles come within control range of preceding cars.

It was felt that Auto-Control, or some other concept of automatic vehicle control, would have its principal applications on turnpikes or other types of limited access highways outside urban or metropolitan areas.

Possibilities of Electric Automobile

A joint long-range development project to explore the possibilities of a revolutionary electric automobile has been announced by George Romney, president of American Motors Corporation (AM), and I. I. Schachtel, president of Sonotone Corporation, Elmsford, N.Y., electronics firm.

At present, the chief drawback of electric powered automobiles is the need for recharging the batteries after less than 100 miles of travel. Aim of the new AM–Sonotone project is to develop an electric power plant which would be constantly recharged during operation by a generator operated by a small high-performance engine. Similar experimental power plants tried in the past have failed because of excessive battery size and weight capacity and short life.

The "heart" of the vehicle project will be a sintered-plate, nickel-cadmium battery, like those used in missiles and jet aircraft. This type of battery, first produced in the United States by Sonotone, is smaller and lighter than conventional batteries of comparable energy output. Although it costs substantially more to produce, it can withstand great overloads or surges of power and can be recharged in a fraction of the time of conventional batteries, Mr. Schachtel pointed out. It has a long life and the original battery is expected to last the life of an electric auto, he added.

Under the joint project, research work will take place at plants of both American Motors and Sonotone. It was stated that the program, which could take several years, might not result in a vehicle which would prove feasible and economical, but that it was decided to launch this development project to see whether a more efficient automobile might result.

Mr. Romney said the research program will seek answers to the fundamental questions of cost, economy of operation, performance, vehicle size and weight, and others.

Home Solar Power Fed into Power Lines

Some day the power companies may be paying you, instead of sending along a monthly bill.

This fascinating possibility was offered recently by Dr. L. J. Giacoletto, who is manager of the electronics department of Ford Motor Company's Scientific Laboratory. He addressed a meeting of the Engineers' Society of Milwaukee.

"The possiblity of solar power—using sunshine to generate electricity—is not new," Dr. Giacoletto said. "However, up to now there has been no feasible plan proposed to store this power."

He offered this solution: Instead of trying to store sun-generated power for individual use, turn excess electricity back into the power lines for daytime industrial use and receive credit for it.

"Meters that measure the electricity drawn by a home already work both ways," he pointed out. "Electricity generated simply would reverse a meter's action, subtracting from the kilowatt-hours of energy previously used."

Calculations have been made to determine the annual electricity consumption, and probable solar energy recovery, for a typical Milwaukee–Chicago–Detroit-area residence.

"Using a bank of semiconductor solar energy cells (similar to transistors) covering an average roof of about 30 feet by 30 feet size, a home owner would generate three times more energy than he would use," Dr. Giacoletto said. "This represents a potential net return over the year of approximately $200. And many cities average more sunshine per year than Detroit."

Here's how it would work:

Semiconductor cells would convert solar power into direct current electricity. This power would then drive a d-c motor which, in turn, would be mechanically coupled to a 60-cycle alternator connected directly to power lines.

Solar power thus would be fed into the lines for local use or, if demand was not sufficient, would be moved into the distribution system that averages out power demands over large areas covered by interconnected power companies.

At present, the cost of a large semiconductor solar converter would be prohibitive. However, Dr. Giacoletto said this cost is predominantly one of fabrication, and that future scientific and technical advances will make the system economically attractive.

Further Improvements Made in Artificial Larynx Devices

In Experimental Stage. An artificial larynx for persons who have lost their voices through surgical removal (laryngectomy) or paralysis of their vocal cords was described recently by three Bell Telephone Laboratories scientists at a meeting of the Acoustical Society of America, in Ottawa, Ont., Canada. Still in the experimental stage, it is the result of a considerable background of research in an interdisciplinary field of science known as psychoacoustics.

With a minimum of difficulty and training, laryngectomees can use the new electronic larynx to speak conversationally. It is especially effective when conversing over the telephone. By means of a finger-operated combination push-to-talk switch and inflection control, the user can easily control the pitch of his artificial voice, thus giving his speech a natural sounding quality previously unobtainable.

The underlying principle of the new artificial larynx is a vibrating driver (transducer) held against the throat. Completely self-contained and cylindrically shaped, it measures only 1¾ inches in diameter by 3¼ inches long, making it comparatively unobtrusive. Included in this one small package is a modified telephone receiver serving as the throat vibrator, a highly efficient transistorized pulse generator with pitch control, and a battery power supply. In order to miniaturize the new artificial larynx, experimental units were built using modular techniques. However, by employing printed-circuit techniques, it is

anticipated that an even more compact unit can be built.

To use the unit, the laryngectomized person presses the vibrator against his throat. Switching on the pulse generator with his finger, he transforms vibrations transmitted into his throat cavities into speech sounds by normal use of the articulatory mechanisms—throat cavity or pharynx, tongue, mouth, teeth, and lips—in his vocal tract.

Output speech volume obtained with the artificial larynx is equal to that of a person speaking at a normal conversational level, though the sound is a bit buzzy and mechanical. Nevertheless, the frequency spectra of vowel sounds show that the frequency range transmitted into the person's throat is sufficient for satisfactory production of such sounds. And while intelligibility tests give results lower than those of normal speech, they are superior to those of any other artificial larynx. Users of the new artificial larynx can achieve a sentence intelligibility of 97% or more, depending on their experience.

Because the artificial larynx requires an economical, self-contained power source, circuit parameters had to be adjusted to yield maximum acoustic output with a minimum of current drain. Accordingly, two transistors are used in a relaxation oscillator the frequency of which is controlled by a variable resistance, and the pulse width of which is determined by a feedback network. The output is a negative pulse which occurs at a frequency of about 100 cycles per second. This repetition frequency may be varied from about 100 to 200 cycles by a rheostat which the user operates by pressure on the push-to-talk switch—or inflection control—while speaking, thus changing the pitch of his voice. For use by women talkers, the frequency range is adjusted to 200 to 400 cycles, to correspond with the normal range of pitch of a woman's voice.

A third transistor acts as a single-ended power output stage that amplifies the pulses applied to it from the relaxation oscillator. A diode serves to isolate the multivibrator from the power amplifier input impedance during the period between pulses, and is necessary for stable operation. Because a large pulse is required for sufficient acoustic power output at low frequencies, the relaxation oscillator drive circuit has heavy current requirements.

Two 5.2-volt mercury cells in series provide the power necessary to operate the artificial larynx continuously for a period of approximately 12 hours. These batteries have a 250-ma hour rating with a maximum permissible current drain of 25 ma. With push-to-talk operation such as the laryngectomized patient requires, 12 hours of continuous operation should be equivalent to several days or even weeks of normal talking.

An alternative to using the self-contained mercury cells for powering the artificial larynx is a small a-c power supply which can be fed from a normal wall outlet at home or in the office. When the artificial larynx is plugged into the power supply, its batteries are disconnected from the circuit.

Portable Device Produced. Another device, designed to take advantage of the ability of voiceless people to form sounds by shaping their mouths and lips, is the Electro-Larynx, a hand-operated, portable instrument, which artificially vibrates a column of air in the esophagus, from which normal speaking sounds can be produced.

ELECTRONIC artificial larynx, developed by Bell Telephone Labs, utilizes a modified telephone receiver—diaphragm with small center disk attached—which transmits sound through flesh into person's throat. By manipulating pitch control switch while talking, user's "artificial voice" can sound very natural.

Invented by Gilbert Wright of Malibu, Calif., and developed by Kett Engineering Corporation of Santa Monica, Calif., the Electro-Larynx is primarily intended as a speaking device for persons who have had their vocal chords removed by surgery, but can also be used by people who lost all or part of the use of their vocal chords for other reasons.

According to its developer, the new device can be used almost immediately and can be mastered after a half hour's practice. In operation, the Electro-Larynx is held firmly against the throat so that the vibrating grid is near the "Adam's Apple." By pressing the switch, a mechanical sound is produced in the throat cavity. According to Cliff Petersen, president of the company, "since the sound produced by the Electro-Larynx is replacing the original sound produced by the larynx, anyone who has normal control of his lips, tongue and mouth, can modulate this sound into very intelligible speech.

"Previous models of the electronic voice were more cumbersome and difficult to carry around," Peterson said. "The new model, Mark 111, is a portable unit in a compact case that is completely self-contained. The outstanding feature of the new models is the nickel-cadmium batteries which activate the vibrator. Produced specifically for us by Gulton Industries, Inc., Metuchen, N. J., they are lifetime rechargeable batteries that require no maintenance or care. Supplied with two batteries, the units will operate for an entire day's talking on one battery, while the other battery is being recharged in the recharging unit provided in the carrying case."

In reality, the Electro-Larynx is a very simple vibrator or buzzer. When held against the esophagus, it vibrates a column of air in the throat which can easily be formed into clear and intelligible words. Weighing less than one pound, the voice-giving instrument is smaller than a standard household flashlight and enables people to speak with mechanical but understandable sounds.

CHILD demonstrates simplicity of operation of portable electronic larynx, produced by Gulton Industries, Inc. Weighing less than a pound, and smaller than a standard flashlight, the device utilizes nickel-cadmium batteries which activate the vibrator.

Color Film Analyzers Demonstrated at SPSE Meeting

Two instantaneous electronic Color Film Analyzers recently leased by Pathe Laboratories, Inc., New York, N. Y., from Hazeltine Research Corporation, Little Neck, N. Y., were demonstrated at a meeting of the New York Chapter of the Society of Photographic Scientists and Engineers (SPSE).

The instrument, developed by Hazeltine with the close co-operation of Pathe engineers, provides immediate information for setting up printers for high quality positive prints from original negative or positive color or black-and-white film for motion pictures or still photography.

The demonstration showed how a desirable print can be obtained at the first printing attempt using data provided by the Analyzer. The first prints of a motion picture timed with and without the aid of the Analyzer attested to the improved quality of the print timed with the electronic Analyzer. Using conventional methods to obtain positive prints, several trial prints are usually necessary to evaluate and correct for proper balance and printing density.

When original or intermediate film is placed on the Color-Film Analyzer, electrical signals corresponding to the scene on the film are produced. These signals are modified to take on all the characteristics of the film or paper print stock and the effects of printing and processing. They are then displayed on a color television tube to form a positive color picture. Adjustments can be made to vary instantaneously the color balance and brightness of this picture. These will indicate the printing-light quality which will produce the optimum color balance and printing density on the finished positive film.

Pathe Laboratories has leased one Color Film Analyzer for its New York City laboratory and another for its Los Angeles operation. Both are designed for 35-mm and 16-mm film, additive and subtractive printers, and positive or negative originals. During 1958, Pathe and other laboratories used a prototype model in Hazeltine's research laboratory and reported excellent results.

Plasma Thermocouple Converts Energy Directly

The first known direct conversion of nuclear reactor energy into electric power—a major scientific breakthrough—was reported in April by The University of Michigan and Los Alamos, N. M., Scientific Laboratory.

R. W. Pidd, professor of physics at The University of Michigan, who played a prominent role in this achievement, said the process would cut by perhaps one half the present cost of building power reactors, pave the way for interplanetary space travel because of the possible tremendous reduction in fuel deadweight loads now necessary to propel a rocket into space, enable satellites to have a small but comparatively powerful and long-lasting source of electricity with which to telemeter data back to earth, and have great significance in submarine propulsion.

Under the process, electric power is obtained from a nuclear reactor containing a uranium carbide source surrounded by a plasma or electrified gas made from cesium. When the reactor is turned on, atomic fission causes the uranium to have such an energy release that it turns white hot. At this temperature, a large electric current is produced and is then transmitted by the gas to a collector from which it can be put into use.

The technique, called a plasma thermocouple, eliminates virtually all but the nuclear reactor in the production of electric power from fission. This means boilers, turbines, gas condensers, and dynamos, such as go to make up the Enrico Fermi Reactor near Monroe, Mich., or the combined Government-industry reactor at Shippingport, Pa., will not be necessary in the future.

Prof. Pidd said it would be some time before a commercial reactor utilizing the new process could be constructed because there is customarily a 3- to 5-year lag between science and engineering. He added, however, that a research reactor could be in operation in 2 years.

Such a commercial reactor could not yet compete with coal power without Government support, he explained, but the over-all economic significance lies in the fact that the known power reserves of uranium exceed many, many times that of coal and oil.

Basically, a thermocouple is a well-known means of producing electricity by bringing two different metals into contact, then cooling one metal and heating the other. The Los Alamos thermocouple is the result of a laboratory observation, made in July 1958, that substituting ionized cesium gas (plasma) for one of the metallic elements produced direct current at several hundred times the power of earlier thermocouples.

The experimental plasma thermocouple resembles in size and shape an empty frozen fruit juice can. The source of power is a rod about ¼-inch in diameter and ¾-inch long containing uranium carbide. This is suspended in the center of the cell and surrounded by cesium gas. When the assembly is lowered into the core of a reactor, the neutron flux activates uranium fission heating in the center of the can, and the flow of reactor coolant around the outside of the can drops the temperature of the cesium plasma. Thus, the essential requirements of a thermocouple are met, and electricity is produced.

Prof. Pidd said the "enormously simple" device was research-tested for the first time in April at the Omega West reactor at Los Alamos.

The laboratory-developed plasma thermocouple was placed in the core of a research reactor. Modestly calculated to produce enough power to light an electric bulb for a few minutes, the lifetime of the device far exceeded all expectations. Acting like a superpowered flashlight battery—with an open-circuit voltage of 3.8 volts and a short-circuit current between 30 and 40 amperes—the thermocouple was operated at design efficiency for almost 12 hours before it was shut down and dismantled for analysis.

When this single cell is extrapolated to an entire reactor, the implications of a successful plasma thermocouple to future atomic energy developments are enormous, the Laboratory scientists feel.

According to Prof. Pidd, "This could be the device that changes the reactor from a scientific instrument to a practical source of useful power, a goal that has been sought since the invention of the reactor." He indicated that interplanetary space travel could profit from the development in that a few pounds of apparatus could replace many times that weight of fuel now needed to thrust rockets into space. Hence, the payload of rockets could be increased measurably. The technique also should ease the present problem of data transmission from satellites which, because of their size, have power units of very limited capacity. An ounce or so of cesium gas provides all the conversion equipment needed to produce power for an extended period of time.

NSF Invites Proposals for Summer Institutes in 1960

The National Science Foundation (NSF) announced recently that proposals are now being accepted for the support of Summer Institutes in 1960 for the supplementary training of secondary school and college science and mathematics teachers and for college teachers of engineering. Proposals are also being accepted for summer institutes for staff members of technical curriculums in junior colleges and technical institutes. Universities and colleges that wish to sponsor such institutes are invited to request information and the necessary forms from the Program Director for Summer Institutes, National Science Foundation, Washington 25, D. C. The deadline for the submission of proposals in final form is August 1, 1959.

Approximately 350 institutes are scheduled for the summer of 1959. They will be held in the District of Columbia, Puerto Rico, and all 50 States. The Foundation expects to provide financial support for a similar number of summer institutes in 1960.

The specific objective of the institutes is to improve the subject-matter mastery of the participating teachers. Nearly all of the institutes are planned and conducted by colleges or universities, and they commonly last from 6 to 10 weeks. It is hoped that a considerable number of the institutes in 1960 will be specifically designed for teachers who have the capacity to benefit from any additional training but who have meager backgrounds in those subjects which they are required to teach.

Foundation funds enable sponsoring colleges and universities to pay stipends to participating teachers, plus allowances for dependents and travel. The participants are exempt from payment of tuition and fees, since the Foundation pays the principal operating costs of the institutes.

The number of participants varies from institute to institute, but averages about 50. Participants are chosen by the host institution in each case. Teachers submit their applications directly to the sponsoring institution, rather than to the Foundation.

Study of Lightning Effects

An extensive study of the lightning performance of an experimental, 460,000-volt electric power line to be built in Pennsylvania will be made by the General Electric Company's (GE) High Voltage Laboratory, in co-operation with Pennsylvania Electric Company (Penelec), Johnstown, Pa.

Plans for the 12½-mile line were announced recently by Penelec. A major portion of the apparatus associated with the line will be furnished by GE, including a 460-kv transformer for one terminal, switching and coupling equipment for both terminals, complete arrester protection, and half of the line insulators and insulator hardware.

For the lightning study electromagnetic models of towers, conductors, and terminal equipment will be built in the Laboratory and tested with "artificial lightning" to predict the lightning performance.

Penelec's 460,000-volt line will be built in a rugged and mountainous area subject to a large number of electrical storms and lightning strokes. The area's "isokeraunic level" (a measurement of lightning frequency) is about 60% above that of Berkshire County in western Massachusetts, where GE and six co-operating companies are now building a 4½-mile prototype transmission line, Project EHV, which will carry power at various voltages up to

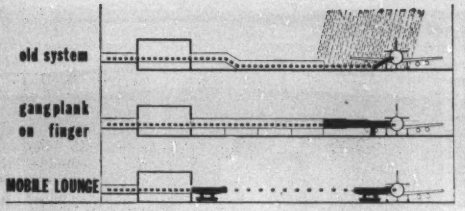
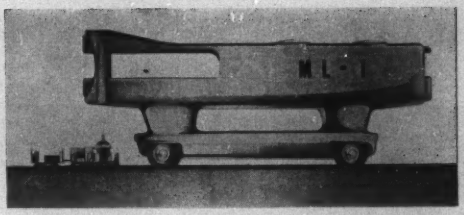


CHART gives comparison of mobile lounge, adopted by FAA for use at Washington International Airport, with old system requiring long walk to plane, and with "finger" or enclosed walkway system.



DRAWING shows model of mobile lounge, a new concept of transportation of airline passengers between terminal building and parked aircraft, eliminating much of walking distance.

750,000 volts *(Electrical Engineering,* Aug. 1958, pp. 669-74).

Dr. P. A. Abetti, manager of Project EHV, announced that his organization would join with Penelec in the instrumentation of the 460,000-volt line and carrying out the study. "After the line is built," said Dr. Abetti, "we shall determine its behavior under lightning, through the use of instruments which measure all the characteristics of lightning. We shall evaluate the actual results, and compare them with what we predicted."

It is vitally important, he continued that high-voltage research in various areas be co-ordinated. GE's participation in the Penelec project assures such co-ordination with Project EHV.

Object of all research in extra-high-voltage transmission is to increase reliability and reduce the cost of electric power to consumers. Extra-high voltage is the solution to the problem of transmitting large blocks of power for long distances, economically and reliably.

Washington Airport To Use "Mobile Lounges"

Adoption of a new "mobile lounge" concept of transporting airline passengers between the terminal building and parked aircraft at Washington's planned jet International Airport at Chantilly, Va., was announced recently by Deputy Administrator J. T. Pyle, Federal Aviation Agency (FAA).

In the initial planning of the airport it became apparent that to provide the number of gate positions which will ultimately be required, the walking distances between a central terminal through "fingers" (long, enclosed, passenger walkways) would become intolerable. In order to accommodate an ultimate parking apron capable of holding 90 large aircraft simultaneously, the architects and engineers for the airport developed the mobile lounge so that the maximum walking distance for passengers will never exceed a few hundred feet.

The transportation of passengers from the terminal building to aircraft is not of itself a new idea. European airports have utilized buses of various types to perform this function. This is the first time that a specially designed vehicle has been proposed for this purpose.

The mobile lounge is envisioned as a vehicle approximately 60 feet long and 15 feet wide, standing on cushioned stilts and wheels. It will provide for the loading of passengers at the second level of a terminal building, unloading them onto aircraft at the floor level of the plane. The vehicle would load from either end, like a ferry-boat, eliminating the need to turn around.

The current trend of airports is to enlarge the fingers through which passengers walk to aircraft loading positions so that there is a "departure lounge" at each loading position into which aircraft passengers can be marshalled. The mobile lounge vehicle provides the equivalent space of a departure lounge, seating up to 80 passengers in comfort, and rendering unnecessary the long walks required at most of today's terminals.

For example, the passenger would enter the main terminal building, walk a few steps to the proper airline counter, and check in with his baggage. He would find loading gates located in a row along the wall opposite the main entrance. There would be no bewildering maze of concourses. Loading gates would be grouped logically according to the airlines they served. There, the mobile lounges would be docked. Just before departure time, the lounge would be "buttoned up," moving swiftly away from the terminal, an air-conditioning system providing a continuous supply of fresh air. As the lounge reached the plane, pneumatic units at the front of the lounge would press against the airplane fuselage, forming a sealed unit, and allowing the passengers to walk directly into the plane.

The vehicle is economically feasible in that it eliminates the need for fingers, now in wide use at many airports, and for separate departure lounges. One of the prime advantages of the mobile lounge is the resultant simplification of airline procedure.

In announcing the adoption of the mobile lounge concept, Mr. Pyle said that the FAA would proceed immediately with plans to award a contract for the development of the vehicle. It is contemplated that under one contract, the vehicle would be designed and a prototype produced and tested at a major airport, to be selected. The target date for the completion of the prototype vehicle will be January 1, 1960. Following complete tests on the vehicle over a period of approximately three months, arrangements will be made to have it manufactured in quantity. During the initial years of the airport's operation, 20 vehicles will be required to service the 30 airline parking positions that will be provided.

Flight Training for the Jet-Space Age

Man's ability to design and build supersonic aircraft has far outdistanced his ability to fly and operate them as military weapon systems. That is why complex electronic and electromechanical devices are called upon to help him fly, direct, and use aircraft for specific missions.

As speeds, altitudes, and weapon systems capabilities increase through continuing research and development, the training of the airmen responsible for using the aircraft to its fullest potential must be more varied and intense. At speeds of Mach 2 and beyond, any delay in reaction would almost certainly mean the loss of men and equipment. Man must be trained to react instantaneously.

How is man to control and operate supersonic aircraft with maximum effectiveness and efficiency without intolerable risk of life and property?

This problem became apparent shortly after the end of World War II, when jets passed from the development stage to reality. The training of pilots and crews for the jet age imposed severe demands in terms of time, money, and the teaching of new skills required to handle the ever-growing complexities of the aircraft, particularly in the area of electronics.

The development and production of synthetic training devices, more commonly known as electronic flight simulators, for nearly every postwar military aircraft used by the U.S. Navy and Air Force was inevitable.

One of the pioneers in the simulator field was the Engineering and Research Corporation, now the Nuclear Products—Erco Division of ACF Industries, Incorporated. It has developed and built nearly 150 training devices for 15 basic types of Navy and Air Force aircraft, including a Navy blimp used for antisubmarine warfare. Since 1949, when it produced its first simulator (for the Navy *F9F-2* Grumman Panther), Erco's sales have been vast, including numerous contracts for modification and maintenance work.

FLYING ON WHEELS is easy in a trailerized Navy P2V Neptune simulator. Cutaway view shows compact arrangement of cockpit, instructor's station, and banks of computers.

SAC PILOTS check out flight simulator for Air Force KC-135 by "flying a problem" created by instructor at panel on right. Computers reproduce all flight characteristics.

Basically, a simulator is a device that duplicates an equipment's operation. This device becomes the actual classroom and can be either stationary or mobile. In the case of a flight simulator, the aerodynamic and power-plant characteristics are presented to the pilot in visual, aural, and instrument indications, with corresponding "feel" and environment. Normal or emergency flight conditions, and meteorological, navigation, and communication data are programmed into the simulators by the instructor–operator.

Faithful duplication of all these flight characteristics is provided by analog computers that function as the "mind" of the simulator. These computers cause the instruments and controls to respond in all situations that would be encountered in the actual aircraft. Any movement of the pilot's control column, rudder pedals, trim controls, or throttles is transmitted to the appropriate computer or computers. These calculate the exact effect which such movement would have in the actual aircraft in change of direction, or speed, or both. Through servomechanisms, the computers alter the readings of the related instruments and trigger the hydraulic actuators to impart any resulting motion in pitch or roll to the cockpit. If throttle settings are changed, the fuel consumption computer, the tachometers, and other engine instruments are affected and the readings of the fuel gauges change. Raising or lowering the flaps and landing gear directly affects the indications of air speed and trim. As the simulated aircraft "gains altitude" its normal increase in true airspeed and decrease in indicated airspeed and fuel consumption are continuously calculated by the altitude computer, which transmits its finding to the altimeter, airspeed and Mach indicators, and fuel consumption gauges.

In fact, practically any action by any of the flight personnel which would affect the performance of the actual aircraft produces an identical result in the simulator. In-flight checks concerning radar, weather observation, navigation, tactics proficiency, and observation of reactions to emergency conditions can be made by the instructor.

Cost-saving is just as important as time-saving in flight training. "Crashing" a simulator—and they do "crash"—results in nothing more than an ear-splitting sound effect and a bruised ego for the student. After a "crash" the instructor may reset the problem at the point of the student's mistake and repeat the flight from that point. The instructor also can "freeze" a flight problem at any point and discuss alternative actions with the student. By successfully coping with problems in the simulator, the student is able to approach his first actual flight with confidence.

NAVY F4D SKYRAY flight simulators are shown near completion as technicians at the Erco plant of ACF Industries wire cockpit panels and control loading equipment. These operational and tactical trainers save equipment and personnel in training.

NEW BOOKS

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

THE BUILDING OF THE TVA. By J. H. Kyle. Louisiana State University Press, Baton Rouge 3, La., 1958, 162 pages. 7 1/3 by 10 1/3 inches, bound. $7.50. This illustrated history of the TVA was written in honor of its 25th Anniversary. The 20 dams and 8 steam plants extending over five states and 41,000 square miles in the Tennessee River Basin are described and profusely illustrated with diagrams and photographs.

DICTIONARY OF GUIDED MISSILES AND SPACE FLIGHT. (Principles of Guided Missile Design, Volume 5.) Edited by Grayson Merrill. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N. J., 1959. 688 pages, 7¼ by 10¼ inches, bound. $17.50. This

is a reference work for persons concerned with research, design, or operation of guided missiles and spacecraft. The terms defined and explained comprise the names of guided missiles and spacecraft; the various guidance and control, propulsion armament, and launching systems of which they are formed; the components that make up those systems; and related terms from aerodynamics, astrodynamics, electronics, astronomy, and physics. Also given are terms for types of antennas, circuits, radar systems, and propellants as well as important laws, relationships, equations, space environments, and concepts which govern design.

ELECTRIC CRANES. By H. H. Broughton. Third edition. E. & F. N. Spon, Ltd., London, England, 1958. 511 pages, 7½ by 10 inches, bound. £7 10s. The present edition has been completely rewritten and newly illustrated. In general, it contains information considered to be useful to those interested in mechanical handling with particular reference to the design, construction, and application of electric cranes. Details are also given of recent authoritative structural, mechanical, and electrical research affecting the design and operation of cranes. Concluding chapters describe overhead traveling cranes, jib cranes, bulk unloaders and grabbing cranes, and fitting-out cranes. Numerous illustrations and tables as well as lists of references add to the value of the book.

ELECTRICAL SAFETY. By H. W. Swann. Philosophical Library, 15 East 40th St., New York 16, N. Y., 1959. 292 pages, 5½ by 8¾ inches, bound. $15. Although particularly related to British practice as exemplified in the Factory Acts, there is a considerable amount of information in this volume which is general in nature. Topics discussed include physical aspects of electricity, adequacy and maintenance, cables and lines, automatic protection, switchboards, inflammable surroundings, and static electrification in relation to fire and explosion risks.

ELECTRONIC CIRCUIT THEORY. By H. J. Zimmerman and S. J. Mason. John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1959. 564 pages, 6 by 9¼ inches, bound. $10.75. The authors' approach to electronics is based on circuit models in order to reduce the number of separate ideas and concepts required. In particular, circuit models having linear elements or pieces are used to convert a nonlinear circuit problem to a number of related linear problems. Thus, the mathematics of linear circuit theory can be applied to a broad class of physical circuits and systems operating in a nonlinear manner. Models are devised to approximate the characteristics of diodes, triodes, pentodes, transistors, and other control devices, and graphical and geometrical interpretations of analyses are given. The effect of circuit and signal on device operation is shown by means of locus plots. Among the basic circuit functions considered are rectification and detection, waveshaping and amplification, and waveform generation.

IES LIGHTING HANDBOOK. Third edition. Published by the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y., 1959. Various pagings, 6¼ by 9¼ inches, bound. $10. In this detailed revision of a practical handbook, the first half is concerned with general concepts and covers the physics of light, light and vision, standards and nomenclature, measurement of light and other radiant energy, color, light control, light sources, and lighting calculations. The second half deals with specific applications including offices and schools, institutions and public buildings, industries, residential lighting, outdoor lighting, sports lighting, roadway lighting, and transportation lighting.

LAW FOR ENGINEERS AND ARCHITECTS. By L. P. Simpson. Fourth edition. West Publishing Company, St. Paul 2, Minn., 1958. 506 pages, 7¾ by 10¼ inches, bound. $7.50. Those branches of the law which bear most directly upon the engineering profession are discussed and illustrated by means of cases which show how the courts have applied the rules stated in the text to concrete situations involving engineers, architects, builders, and owners. The first half of the book is devoted to contracts; the second half is concerned with the law of agency, mechanics' liens, workmen's compensation, and property. Standard forms of construction contracts, invitations to bidders, subcontracts, and contracts between architect and owner are given in the appendix.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by AIEE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 W. 39 St., New York 18, N. Y.

MATHEMATICS DICTIONARY. Edited by Glenn James and R. C. James. Multilingual edition. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N. J., 1959. 546 pages, 6¼ by 9¼ inches, bound. $15. Substantially revised and enlarged, this edition contains more than 7,000 mathematical terms, concepts, and relationships ranging from elementary terms in arithmetic through calculus. In addition, multilingual indexes giving their Russian, German, French, and Spanish equivalents are provided. New basic terms have been added in the fields of modern algebra, number theory, topology, vector spaces, the theory of games, linear and dynamic programming, numerical analysis, and computing machines. Useful tables and an extensive list of mathematical symbols are given in the appendix.

NATIONAL ELECTRONICS CONFERENCE PROCEEDINGS, VOLUME XIV. Published by the National Electronics Conference, Inc., 228 N. LaSalle St., Chicago 1, Ill., 1959. 1,074 pages, 6¼ by 9¼ inches, bound. $7.50. This collection of papers constitutes an extensive review of current developments within the field of electronics. The wide variety of topics discussed include transistors, servomechanisms, antennas, audio, automatic navigation, filter design, solid state, microwaves, instrumentation, network theory, noise and data smoothing, computers, radar and radio navigation, magnetic amplifiers, industrial electronics, television, and communications.

THE PHYSICS OF ELECTRICITY AND MAGNETISM. By W. T. Scott. John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1959. 635 pages, 6 by 9¼ inches, bound. $8.75. The basic theory of electricity and magnetism is treated in a rigorous manner from the viewpoint of the physicist. A modern atomic approach is used to describe such phenomena as metallic conduction and the production of chemical and thermal electromotive forces. Topics discussed are charge, field, and potential; metallic conductors; dielectric materials; steady currents; electron levels; magnetic field and materials; alternating currents; and electromagnetic radiation. A fully descriptive and mathematical treatment is given using vector notation and intermediate calculus.

POWER PLANT THEORY AND DESIGN. By P. J. Potter. Second edition. The Ronald Press Company, 15 E. 26th St., New York 10, N. Y., 1959. 710 pages, 6½ by 9½ inches, bound. $10.50. This revised edition of the author's "Steam Power Plants" covers the entire range of power generating equipment, with particular emphasis upon the steam plant as the basic element. Although it gives principal attention to large central power station design, the book also discusses the smaller industrial plants, as well as gas, hydroelectric, and nuclear plants. Recent advances are given in the design of such equipment as cyclone furnaces, pressurized boilers, and demineralizing equipment. The economic aspects of equipment selection receive increased emphasis and the proper selection of pipe sizes, insulation thickness, heater terminal differences, and station pressures and temperatures are fully discussed.

PREPARATION OF SINGLE CRYSTALS. By W. D. Lawson and S. Neilson. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 255 pages, 5½ by 8¾ inches, bound. $8.80. The book is concerned with the practice of growing purer and more perfect single crystals of semiconducting compounds. The authors start with a discussion of techniques for growing crystals, especially for growing from the melt and from the vapor, and include practical details of apparatus that can be constructed readily. They continue with methods for the purification of the starting material and the semiconductors themselves, and with techniques for handling the purified materials, for the preparation of semiconducting compounds, and for the detection and estimation of trace impurities. A nonmathematical approach to the mechanism of crystal growth and of the origin of imperfections in crystals is also presented.

PROBLEMS AND SOLUTIONS, VOLUME II. By C. E. Harrington. Published by the author, 45 Elk St., Springville, N. Y., 1959. 138 pages, 8½ by 11 inches, paper. $2.75. This is a review of the material which is likely to be contained in parts 2 and 3 of the New York State Professional Engineering Examinations. Many of the problems usually asked in these examinations have their counterpart presented in this volume, which covers the period from 1955-58. Little attempt is made to answer descriptive problems, but rather to answer those problems which have a mathematical solution.

PROFESSIONAL CREATIVITY. By E. K. Von Flange. Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y., 1959. 260 pages, 5¾ by 8½ inches, bound. $4.95. The present volume is the result of creative seminars held by the General Electric Company for its professional personnel. The first part is intended to give insight into the creative process by showing what creativity is, and how to utilize mental powers and resources to the fullest extent to create ideas. The latter part discusses in detail the planning of creative work to insure that worthwhile objectives are established, that the creative work, itself, is conducted efficiently, and that the results, when achieved, will be accepted by others.

DIE SCHALTUNG DER LEISTUNGSTRANSFORMATOREN. By Fritz Andé. Springer-Verlag, Berlin, Germany, 1959. 332 pages, 6¼ by 9½ inches, bound. 42.50 DM. Circuits of power transformers are comprehensively treated in this text and handbook for both students and engineers. The range of the book extends from simple to complicated circuits, windings, and combinations. Detailed treatments of the different types of transformers, and for various uses, are given, including 4- and 6-phase circuits, centralization of polyphase circuits, switching controls, and other special aspects.

THE SCIENTIFIC REVOLUTION. Edited by G. W. Elbers and Paul Duncan. Public Affairs Press, 419 New Jersey Ave., S. E., Washington 3, D. C., 1959. 280 pages, 6¼ by 9¼ inches, bound. $6. A long-term assessment of the challenge created by the scientific revolution which the satellite launchings symbolized is presented. The authors open with a discussion of this scientific revolution and its implications for the United States, move on to an appraisal of the problems faced in developing a science program adequate to the Nation's needs, and then evaluate the role of science in society and the effect of a lack of public understanding upon science and the scientist. The concluding sections examine the adequacy of the educational system in providing the human resources needed.

SILICONES. By R. N. Meals and F. M. Lewis. Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y., 1959. 267 pages, 5¼ by 7½ inches, bound. $5.95. The manufacture, properties, and applications of the silicones are described, together with data on the properties of silicone resins, fluids, and rubbers at high temperature. Intended for design engineers, formulators, and manufacturers, this book contains case histories of present industrial applications as well as potential uses. These include the use of silicones as chemicals, rubbers, resins, fluids, greases, adhesives, sealants, surface coatings, and other purposes.

SOLID STATE MAGNETIC AND DIELECTRIC DEVICES. Edited by H. W. Katz. John

Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 1959. 542 pages, 6 by 9¼ inches, bound. $13.50. An account of solid-state devices and components using ferrites and titanates is given. The book begins with a classical treatment of magnetization and polarization and then proceeds to show the general application of these principles to electromechanical devices, small signal devices, ferrites at microwave frequencies, magnetic and dielectric amplifiers, digital techniques employing square loop materials, magnetic recording, and magnetic and dielectric measurements. Appendixes discuss specialized aspects of the subject such as reciprocity in linear systems, magnetoresistance, and parametric devices.

SYMPOSIUM ON ADVANCES IN ELECTRON METALLOGRAPHY. Published as Special Technical Publication No. 245 by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1958. 120 pages, 6 by 9¼ inches, bound. $4. New and comprehensive techniques for the study of materials through the use of the electron microscope are described and include direct transmission electron microscopy, electron probe microanalysis, studies of the microstructure of age-hardenable and heat-resistant alloys, and improved techniques in specimen preparation and replication.

SYMPOSIUM ON CLEANING OF ELECTRONIC DEVICE COMPONENTS AND MATERIALS. Published as Special Technical Publication No. 246 by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1959. 220 pages, 6 by 9¼ inches, bound. $6.50. Papers are presented which discuss various aspects of the current knowledge concerning decontamination of electron devices, including both semiconductors and tubes.

TELEGRAPHY. By J. W. Freebody. Sir Isaac Pitman and Sons, Ltd., London, England, 1959. 738 pages, 7¼ by 10 inches, bound. 80s. The theory and principles of telegraphy upon which practical systems and equipment are based are explained. Detailed information is given on the equipment used by the British Post Office for its inland and overseas public telegraph services and for private wires and Telex. Aspects discussed are electromagnetic relays, line plant, manual switching telegraph systems, automatic switching of telegraph circuits, multichannel voice-frequency systems, start-stop instruments, facsimile and picture telegraph systems, teleprinter private wires and Telex service, and submarine cable telegraphy.

TECHNICAL LITERATURE

The following recently issued technical literature may be of interest to readers of *Electrical Engineering*. All inquiries should be addressed to the issuers.

AMERICAN STANDARDS. A newly revised Guide for Loading Oil-Immersed Distribution and Power Transformers has been published by the American Standards Association (ASA). The guide, C57.92, is an appendix to the C57.12 series of standards, American Standard Power and Distribution Transformers, 1958. The guide is published to facilitate the use of the American Standard, and is not a part of the standard. It covers general recommendations for loading all types of oil-immersed transformers, except water-cooled transformers built before 1929. It may be ordered at $2 per copy. A new American Standard, establishing suggested requirements for automatic circuit reclosers and automatic line sectionalizers for a-c systems, is also available. Designated C37.22-1959, the standard, $1.35 a copy, is based on publications of AIEE and NEMA, and applies to all single-pole and multipole a-c reclosers and sectionalizers for nominal voltages from 1,500 to 23,000 volts. Both publications are available from ASA, 70 E. 45 St., New York 17, N. Y.

1958 ASTM PROCEEDINGS, Vol. 58. The 1,430-page volume, recording the technical accomplishments of the year, includes reports and papers together with discussion offered to the Society during the year and accepted for *Proceedings*. The volume includes the Summary of Proceedings of the ASTM 61st Annual Meeting, listing by title and author the programs for each session. Also included in the volume are the annual report of the Board of Directors, a listing of all symposiums and other special sessions published separately as Special Technical Publications and all papers published in the ASTM Bulletin. There is a subject and author index to all papers published in any form by the Society in 1958. In addition, the *Proceedings* contain much discussion not previously published. Copies may be obtained from ASTM, 1916 Race St., Philadelphia 3, Pa., at $12.

AUTOMATION BIBLIOGRAPHY. This listing contains more than 175 references to books, booklets, magazine articles, pamphlets, and films from over 50 different sources. All items are listed alphabetically by title, together with such other pertinent information as author, publication, issue, page number, etc., for magazines, and author, publisher, number of pages, and price for books. Also available is a 38-page "Glossary of Automation Terms" containing definitions of words and phrases commonly associated with electronic computer terminology. Both of these publications can be secured from the headquarters office of the National Office Management Association at 1931 Old York Rd., Willow Grove, Pa., for $2 each.

U. S. GOVERNMENT AWARDS UNDER THE FULBRIGHT AND SMITH–MUNDT ACTS, 1960-61, University Lecturing, Advanced Research. Listing the countries participating in the program of university lecturing and advanced research awards under the Fulbright Act, the pamphlet details the awards available and general information on each of these countries. The closing date for making application for programs listed in this announcement is Oct. 1, 1959; to be assured of consideration, applications must be mailed by this date. Application forms and additional information are obtainable from the Conference Board of Associated Research Councils, Committee on International Exchange of Persons, 2101 Constitution Ave., Washington 25, D. C.

SCIENTIFIC RESEARCH AND DEVELOPMENT IN COLLEGES AND UNIVERSITIES, Expenditures and Manpower, 1953-54. This report constitutes the final part of the National Science Foundation's survey of the over-all United States research and development effort during 1953-54. The report is divided into four main sections: Introduction; Costs of research and development in colleges and universities, fiscal year 1954; Professional scientific personnel in colleges and universities, academic year 1953-54; and Relationships of expenditures and personnel data. Three appendixes are included—statistical tables, scientific professional personnel in special research organizations, and forms used in survey. This publication is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $1.

ASTM Publications. Two publications recently made available by the American Society for Testing Materials are: STP 245, Symposium on Electron Metallography, 126 pages, hard cover, $4, which covers a broad range of topics including direct transmission electron microscopy, electron probe microanalysis, and new techniques in specimen preparation and replication; and STP 233, The Effect of Radiation on Materials, Vol. III, 168 pages, hard cover, $4.25, last in a series, which deals with dosimetry techniques, radiation facilities and techniques, and radiation effects. Both volumes are available from ASTM, 1916 Race St., Philadelphia 3, Pa.

RESUSCITATION MANUAL. Prepared by the Accident Prevention Committee of the Edison Electric Institute (EEI), the publication is designed to be used as a reference work on the subject of manual resuscitation, and describes and illustrates most of the more successful resuscitation methods. The manual should be useful as a general reference for safety men, first aid men, department heads, and foremen of electric utilities. Another purpose of the manual is to promote understanding and co-operation among the various groups interested in resuscitation techniques and problems. The manual, EEI Publication 59-113, may be ordered as follows: 1-9 copies at 50¢ postpaid in the United States, 10-99 copies at 32¢ postpaid in the United States, 100-499 copies to one address at 24¢ shipped collect, and 500 or more copies to one address at 16¢ shipped collect. Orders or additional information may be obtained from EEI, 750 Third Ave., New York 17, N. Y.

RADIOACTIVE FALLOUT—A TWO-YEAR SUMMARY REPORT. By Dr. C. L. Dunham, director, Division of Biology and Medicine, U. S. Atomic Energy Commission, the summary statement was presented at the hearings on fallout conducted by the Joint Committee on Atomic Energy of the U. S. Congress in May 1959. Seven reports on specific aspects of the Commission's studies relating to fallout have been included as appendixes to Dr. Dunham's statement. The document may be purchased from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for $1.25 per copy.

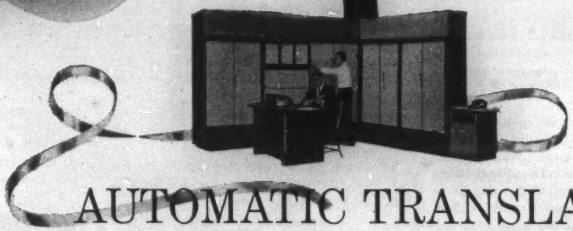
CBS ENGINEER'S HANDBOOK. Recently expanded into two volumes, the handbook covers receiving, special-purpose, and picture tubes, as well as semiconductors, and includes complete EIA engineering design data on current types. It also tabulates quick-reference data on seldom used types, and gives 375 characteristic curves in two colors. An appendix explains terms, symbols, characteristics, and rating systems. Containing over 700 pages, the two volumes are available from CBS Electronics, Danvers, Mass., at $10 for the pair. Periodic supplement service for a 2-year period is optional at an additional $3. Present CBS Handbook owners can obtain separate hard-cover binders for $3 each; two for $5.50.

OTS REPORTS. The development of a fully integrated and readily interpreted flight instrument panel which uses a minimum of weight, space, and power is described in a U. S. Air Force report recently released to industry through the OTS. The report is *PB 151941*, "The Air Force Integrated Flight Instrument Panel," C. Svimonoff, 163 pages, $3. Developments and problems in the field of mechanical translation of languages by means of high-speed electronic computers are analyzed in a U. S. Army report, covering the mechanical translation activities of Government, commercial, and educational institutions in the United States as well as contributions made in England and the USSR. The report *PB 151147*, "Survey of the Field of Mechanical Translation of Languages," G. W. Reitwiesner and M. H. Weik, may be ordered at $1.75. Both publications are available through OTS, U. S. Department of Commerce, Washington 25, D. C.

WEATHER DATA FOR HUMIDITY CONTROL AIR CONDITIONING. Issued by the Electric Space Heating and Air-Conditioning Committee of Edison Electric Institute (EEI), this publication is a compilation of weather data for various areas of the Nation served by some 20 investor-owned electric light and power companies. Figures are given for both the heating and cooling seasons, showing average mean temperatures, dewpoint, humidity, and other data. Copies of the report may be ordered from EEI, 750 Third Ave., New York 17, N. Y., at $1 per copy for EEI member companies, and $1.50 per copy for others.

HANDBOOK PREFERRED CIRCUITS, NAVY AERONAUTICAL ELECTRONIC EQUIPMENT, NAVAER 16-1-519, Supplement No. 1. This first supplement to *Preferred Circuits* includes 5 instrument servo circuits, 2 regulators, 2 high-voltage supplies, a pulse afc and a silicon transistor video amplifier. Schematics of each circuit are provided, with characteristics permitting ready selection and construction; successive pages explain use and design methods. These preferred circuits were derived after experimental measurements had been made on a large number of examples taken from both commercial and military electronic equipment. Supplement No. 1, containing 106 pages, may be ordered at 60¢ from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

автоматический перевод
вычислительные машины
способствуют исследова-
нию языков



AUTOMATIC TRANSLATION

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New and Improved Products . . .

Braille Translator . . .

It is now possible to translate a 300-page book into Braille in one hour, a job which ordinarily takes a skilled translator 6 days to perform. Using an IBM *704* computer, Braille rules are stored in the computer's magnetic tape memory. The book's text is then translated into punched cards and fed into the *704* where it is converted into Braille code at the rate of 4,000 words per minute. The punched card output, now coded and edited for Braille, is then fed into an automatic embossing machine which produces the master plates used to print out each page of raised letters. **International Business Machines Corp., 112 E. Post Rd., White Plains, N.Y.**

Circle 201 on the card.

Thermoelectric Heater–Cooler . . .

Temperature differences up to 70 C can be obtained with the TA-11 thermoelectric junction, where applications call for temperatures above or below the ambient, and where relatively low heat input or extraction is involved. Specific applications can be found in quartz crystal ovens, critical electrical circuits, biological specimens, and other areas requiring constant temperature values. In normal room ambients, with an input of 2 watts, it is possible to obtain a temperature difference in excess of 40 C. With no external heat load, the cold junction temperature is −15 C. **Ohio Semiconductors, Inc., Columbus, Ohio.**

Circle 202 on the card.

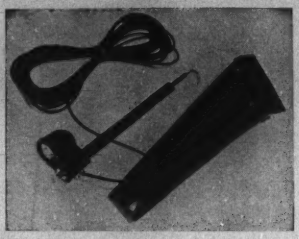
High-Speed Microfilm Printer . . .

Newest member of the series of high-speed microfilm printers, the *S-C 4020* is capable of recording computer output data on film at the rate of 15,000 characters per second. This is accomplished by the combined use of a Charactron shaped-beam tube and a 35-mm recording camera guided and controlled by the logic circuitry unit of the printer. **Stromberg-Carlson, A Division of General Dynamics Corp., Rochester 3, N. Y.**

Circle 203 on the card.

High Line Safety Voltmeter . . .

This portable instrument, consisting of a test prod, series resistance, indicating head, and ground lead, can be used to measure high a-c voltages quickly, easily, and safely in both wet and dry weather. Two scales of 0-5 kv and 0-15 kv can be read at a distance of 8 feet. The lineman or operator is not exposed to the hazard of high-voltage current because in a peak voltage rating of 75 kv, the actual impressed rms voltage is 15 kv and the current flow to ground is 0.6 ma. **Western Electro-Mechanical Co., Inc., 300 Broadway, Oakland 7, Calif.**



Circle 204 on the card.

Submersible Motor . . .

A new 4-inch submersible motor, designed to drive deep well turbine pumps, is said to provide the highest horsepower capacity in a motor of that diameter. This is achieved by using an outside wound stator which is protected by encapsulation in a chemically inert plastisol and sealed in stainless steel. Motor ratings range from 1½ to 5 hp for single phase, and 1½ to 7 hp for 3-phase construction. **The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.**

Circle 205 on the card.

Adaptable High-Voltage Bushings . . .

A new complete line of high-voltage bushings in ratings of 15 kv to 196 kv offers full interchangeability between transformer and circuit breaker type insulators. A basic bushing is available for every voltage class and may be adapted by the addition of terminal fittings such as a 400-ampere draw lead type for transformer and a 1,200-ampere fixed stud type for either transformer or breaker use. **Lapp Insulator Co., Inc., Le Roy, N. Y.**

Circle 206 on the card.

Sequential Sampling Switch . . .

Capable of making more than 3,600 closures per second, this noiseless high-speed sampling switch is actuated by a rotating jet of air. It represents an important innovation in the field of high-speed switching where a large number of voltage-generating elements must be connected successively to a single load. Signals of one, two, and three millivolts can be transmitted free from noise without amplification or filtering of any kind. Applications include use with thermocouples, strain gages, light sensitive devices, and similar low-level high-impedance elements employed in computers, telemetry, and complex control systems. **Electric Regulator Corp., Norwalk, Conn.**

Circle 207 on the card.

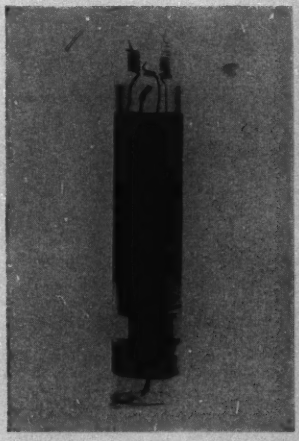
Improved Insulation . . .

Called Polestiglas, this new insulating material is essentially a cast or molded glass reinforced polyester which combines the superior qualities of resistance to tracking and flame, high dielectric and impact strength, and extremely low power factor, moisture absorbency, and corona loss level. Developed to meet the problems of utilities and industry in areas of high humidity and contaminated air, this material is applicable to bus bars, bus supports, and phase barriers in 5- and 15-kv metal-clad switchgear. **Federal Pacific Electric Co., 40 Paris St., Newark 1, N. J.**

Circle 208 on the card.

Deep Sea Pulse Transformer . . .

A pulse transformer which can operate from the deepest point of the ocean has been developed to supply pulse energy to sonar transducers at pressures of 15,000 psi. Designed to trigger a camera's flash



equipment six miles below sea level, the transformer is mounted in an oil-filled Plexiglass container with neoprene rubber end plugs. By oil filling under vacuum to exhaust the contained gas, the unit becomes a solid mass and can resist tremendous pressures. **Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston, Mass.**

Circle 209 on the card.

(Continued on page 20A)

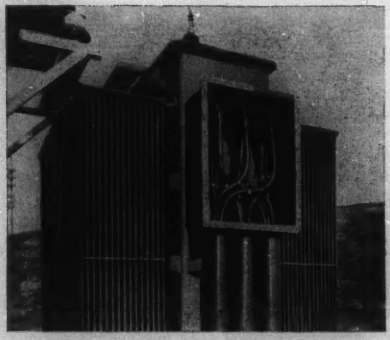
Installed in underground ducts, Paranite Super Pararite-Paraprene® network cable services a modern electronic computor installation.

Paranite Super Pararite-Parasyn cables carry primary power between transformers and switchgear control panels in an ore reduction plant.

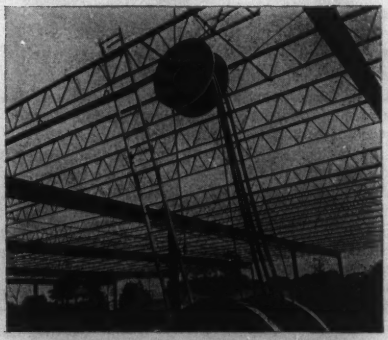
Across the nation for trouble-free installations...

PARANITE®

"IF IT'S PARANITE IT'S RIGHT"®



Paranite Super Pararite-Paraprene cable serves as the primary transformer feeder in a new municipal water pumping station.



Overhead duct installation of Paranite Super Pararite-Parasyn® (PVC) serves as a secondary feeder cable in a manufacturing plant.

The consistent selection and performance of Paranite cables from 600 volt network through 23,000 volt power cables mark them as products of close quality control. These Super Pararite-Paraprene and Super Pararite-Parasyn (PVC) cables illustrated above, indicate the versatility, national availability and proven trouble-free performance of Paranite installations.

PARANITE WIRE AND CABLE DIVISION

Essex Wire Corporation, Fort Wayne, Indiana

MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Birmingham, Ala.; Anaheim, Calif. • Sales Offices in All Principal Cities

For more information circle 13 on reader service card.

high-precision vapor fractometer gets Sorensen transistorized supply

provides "better accuracy" says Perkin-Elmer

Detector for Perkin-Elmer Model 154-C Vapor Fractometer (above) gets highly stable voltage from tiny but precise Sorensen dc supply (below). Dimensions are only 3-9/16 x 3-1/16 x 5 in.

Perkin-Elmer Corporation, Norwalk, Connecticut, selected a modified Sorensen miniature transistorized supply to build into the hot-wire detector unit for their new precision Model 154-C Vapor Fractometer.

They report they're pleased with the speed with which Sorensen modified their standard Model QM miniature voltage-regulated dc supply to fit their specialized requirements and they praised Sorensen's quick deliveries. But here's the statement we, at Sorensen, liked best:

The QM ". . . appears to afford even better regulation than Sorensen's specifications show (better than ±0.05% variation in output voltage for a 10% change in line voltage)." Need we say more?

Sorensen makes the widest line of transistorized power supply equipment on the market today—plus a complete line of electronic and magnetic-amplifier regulators for ac and dc, inverters, converters, and frequency changers, plus a complete line of extremely high-voltage equipment. Write for catalogs. And if you have a special problem or tough specifications to meet, ask the advice of your nearest Sorensen representative—he'll have the answer.

8.48

SORENSEN & COMPANY, INC.

Richards Avenue, South Norwalk, Connecticut

WIDEST LINE OF CONTROLLED-POWER EQUIPMENT FOR RESEARCH AND INDUSTRY

IN EUROPE, contact Sorensen-Ardag, Zurich, Switzerland. **IN WESTERN CANADA,** ARVA. **IN EASTERN CANADA,** Bayly Engineering, Ltd. **IN MEXICO,** Electro Labs, S. A., Mexico City.

New & Improved Products

(Continued from page 18A)

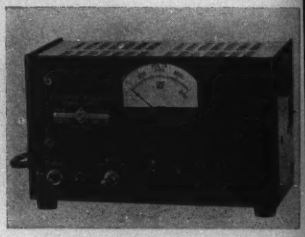
Recording—Projecting Oscillograph . . .

This new instrument called the Datascope is a recording and projecting oscillograph that puts into visual form any type of electrical, optical, acoustical, chemical, or thermal variable. Transient phenomena ranging from d-c to 5,000 cps are permanently recorded on tape which may be transported backward and forward for detailed visual inspection. Transients of very short duration and higher frequencies up to 200,000 cps may be recorded with the aid of a magnetic memory unit soon to be available. **Microsound, Inc., 4627 Leahy St., Culver City, Calif.**

Circle 210 on the card.

Adjustable Regulated Power Supply . . .

Compactness and efficiency have been achieved in this continuously adjustable 120-watt regulated power supply through



the use of a fast-acting *6AV5GA* series regulator and a pair of *5727* full-wave thyratrons. Uniform performance is provided over a 0- to 300-volt d-c output range at 200 ma maximum. **General Radio Co., West Concord, Mass.**

Circle 211 on the card.

Air-Powered Guy-Strand Cutter . . .

This air-powered guy-strand cutter cuts cleanly through steel strand up to ½-inch in diameter in a single stroke. Severed ends of the strand are left smooth and even. It has tempered alloy-steel jaw blades and a strong, lightweight aluminum body. Power can be supplied by compressors or standard cylinders of dry nitrogen. **A. B. Chance Co., Centralia, Mo.**

Circle 212 on the card.

Ceramic Capacitors . . .

A new capacitor, which promises to replace most paper capacitors in the 0.01 and 0.25 μf range and mica capacitors in

(Continued on page 24A)

650 BIL

LAPP STATION POSTS

the station insulators specifically designed for 138 kv service

Use of Lapp Station Posts rated at 650 BIL gives designers of 138 kv systems their first chance for most efficient balance of structure cost and electrical characteristics. As compared with use of 161 kv station insulators (until now the only "safe" construction for 138 kv) these new units provide greater strength and rigidity with less weight . . . permit more flexible, more compact station design, with smaller air break switches . . . are suited to horizontal mounting . . . allow wider spacing of bus supports under short circuit forces . . . all at lower costs for insulators *and* structure.

For best performance, highest reliability, lowest cost, design 138 kv stations on Lapp 650 BIL Station Posts.

Lapp Insulator Co., Inc., Le Roy, New York.

Lapp

Pictured (left to right) Alfred Scheer, Shaw, Metz & Dolio electrical engineer; George Nejdl, asst. electrical engineer for Shaw, Metz & Dolio; P. R. Ellingson, plant engineer, Johnson Motors; R. S. Terhune, Nelson sales representative.

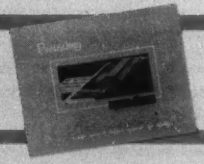
NELSON
helps make your Johnson outboard motors

Seven Nelson unit substations similar to the one pictured above were used in the new Johnson Motors die cast expansion at Waukegan, Illinois. Each unit, compactly designed for ease of operation and maintenance, controls the flow of power to a section of the plant.

The unit shown is substation No. 3. This is a 1,000 KVA unit, rated 12,000 volt delta primary to 480 volt Wye 277 volt secondary, and incorporating Nelson Class 722 low voltage switchgear. This gear includes 1 — 50,000 AIC main and 8 — 25,000 AIC feeder breakers, and has fully equipped spaces for five additional future feeder breakers.

Thanks to the close cooperation on the part of Shaw, Metz & Dolio, architects and engineers of Chicago, the engineer at Johnson Motors, and the contractor, Aldridge Electric Company with Nelson Electric Manufacturing Company, this installation was made to the *complete satisfaction* of all parties.

When you need any type of electrical control equipment, consult NELSON. The type of team work that made the Johnson Motors installation possible can help you streamline your plant for more efficient operation.



To learn more about Nelson Electric Manufacturing Company please write for pictorial index and brochure describing our new plant.

a major source of electrical control equipment for industry

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

Circle 17 on the card.

New & Improved Products

(Continued from page 20A)

no-drift capacities of 300 μμf to .01 μf, is made of ceramic in extruded and molded forms. The extruded type is a tube with a triangular bracing that performs double duty as a structural core and surface area to increase capacitance. The molded type is of solid construction capable of being manufactured automatically in one piece without the use of leads or terminals. **Packard Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.**

Circle 213 on the card.

Line Squelch Handie-Talkie . . .

This new transistorized two-way radiophone hand set is an extension of the "Private Line" mobile equipment introduced several years ago. Using the tone-coded squelch principle, in which incoming messages are blocked from the receiver's audio circuit unless the coded tone is present, the units are compatible and may be used in the same system with mobile equipment. Available in both the 25- to 50-mc and 144- to 174-mc bands, the unit weighs from 7 to 18 pounds depending on power output and the type of battery supply used. **Motorola Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.**

Circle 214 on the card.

Alloy for Electrical Parts . . .

Developed in co-operation with American Metal Climax Co., a new alloy called Amzirc has outstanding features of high-temperature operating characteristics without loss of ductility or high conductivity. Composed of copper and zirconium, the alloy after processing has a softening point of about 600 C. Immediate use is for slip rings, resistance welding wheels and electrodes, soldering iron tips, rectifier bases, nickel-cadmium battery terminals, orifices for reaction motors, motor windings, side rails for vacuum tubes, X-ray tube lugs, anodes for power tubes, and other current-carrying parts and contacts. **Bridgeport Brass Co., 30 Grand St., Bridgeport, Conn.**

Circle 215 on the card.

Flexible Plastic Magnet . . .

Koroseal vinyl plastic can be compounded and processed to react exactly like a metal or ceramic magnet. Cutting will not impair its magnetic properties and it can be produced in continuous lengths of any shape. Attracted to ferrous metals or to itself and yet possessing insulating qualities, its immediate application will be to provide a combination gasket-magnetic latch for refrigerators, kitchen cabinets, washers, and other household appliances. Electronic applications will be in the fields of telephone,

(Continued on page 26A)

"THE NATIVE HOLLANDER WEARS WOODEN SHOES."

A Bell Telephone Laboratories experiment in noise appraisal

"The native Hollander wears wooden shoes."

"Nebraska has no seacoast."

"The daisy is a common wildflower."

As these syllables, words and sentences come in over the telephones, stand-ins for millions of Bell System subscribers rate them for clarity of reception.

From these tests, Bell Telephone Laboratories engineers determine what is objectionable noise, and work to minimize it in telephone circuits. They begin by tape recording background noise associated with working telephone circuits. Test statements of appropriate length and content (such as those above) are read onto a second tape, and both are fed onto the test circuit under carefully controlled conditions. A third tape, of normal room noise, is played through a loudspeaker in the test lab.

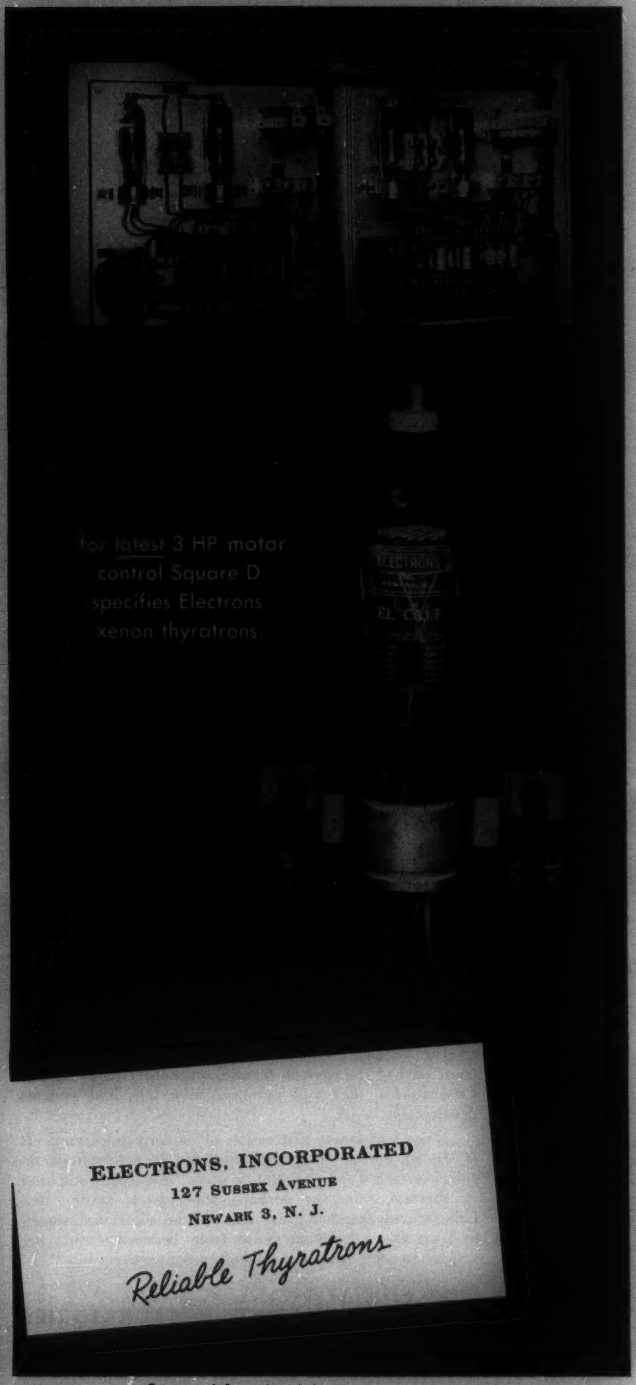
Several hundred listeners, meeting in small groups several times a day for weeks at a time, are then asked to rate the effect of noise on transmission of the various simulated telephone calls.

For the Bell System, the results of the study will become part of the over-all transmission objectives. At Bell Laboratories, they will influence apparatus and systems development work.

Noise is a major distraction of modern day living. It is also an enemy of the Bell System. In a telephone receiver during a call, it might be power line hum, switching or thermal noise, or perhaps atmospheric static. Bell Laboratories spends a great deal of time, effort and money to keep this extraneous noise from becoming annoying and to assure you of a trouble-free connection.

BELL TELEPHONE LABORATORIES

World center of communications research and development



ELECTRONS, INCORPORATED
127 SUSSEX AVENUE
NEWARK 3, N. J.
Reliable Thyratrons

For more information circle 18 on reader-service card.

New & Improved Products

(Continued from page 24A)

radio earphones, hearing aids, and miniature motors. **B. F. Goodrich Industrial Products Co., Akron, Ohio.**

Circle 216 on the card.

Stereo with Only Two Tubes . . .

A pair of *50FY8*'s are the only tubes required in a stereo amplifier using the CBS modified simplex circuit. These new miniature triode-pentodes will provide up to 3.5 watts per channel, allowing the design of a very compact audio amplifier unit. **CBS-Electronics, Danvers, Mass.**

Circle 217 on the card.

Temperature Indicating Labels . . .

Small plastic labels, attachable anywhere because of an adhesive backing, can be used to indicate temperature limits from 100 F through 700 F in a choice of 50 increments with ±1% accuracy. Designed to eliminate the cost, maintenance, and installation of more complex temperature recording devices, the sensitive spots on the label permanently turn

from white to black when the predetermined temperature limit is reached. Present applications are to detect overheating or hot spots on wing surfaces, nozzles, tubing, valves, brakes, radar panels, and other critical points. Development activities are expected to increase the temperature range to 2,000 F. **Pyrodyne, Inc., P.O. Box 49972, Los Angeles 49, Calif.**

Circle 218 on the card.

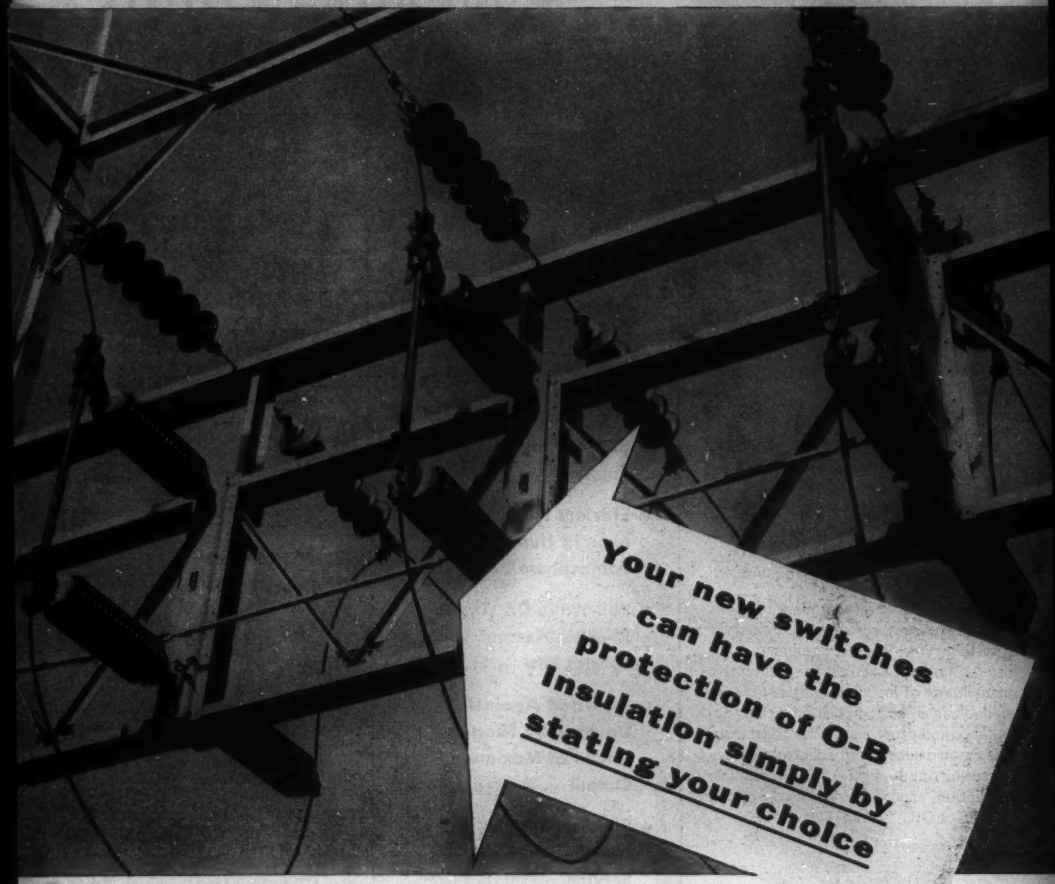
Electronic A-C Voltage Regulators . . .

Two regulators supplying 500 and 1,500 volt-amperes at nominal 115-volts a-c are now offered in militarized versions to meet *MIL-1-4158A* specifications for ground equipment. Output voltage regulation is ±0.5% against variations in input line voltage, load, and power factor charges. **Sorensen & Co., South Norwalk, Conn.**

Circle 219 on the card.

(Continued on page 28A)

Just Ask For It



It's the simplest thing in the world to get reliable insulation on your new switches -- *just ask for it.* Otherwise, you take "pot luck."

Switchgear manufacturers are willing and able to furnish any insulator you prefer. They are probably in stock, or can be obtained at no premium of cost or trouble. But, until you state a choice, the manufacturer is powerless to follow your regular insulator purchasing policy.

All insulators share an equal responsibility for continuity of service. Those on the line are given careful consideration. Why not those in the station?

If your experience is at all typical, a check of your own records will show that, even after 20 or more years, O-B switch insulator replacements are negligible.

. . . And you can do it over again if you simply say "O-B insulation" when new switches and bus supports are bought. Just name it, and you can have it!

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

HOLAN

For more information circle 19 on reader service card.

NEW BIDDLE
DIELECTRIC TEST SET

5KV-1MA

Maximum Output Current 5 MA at Output Voltage up to 4 KV

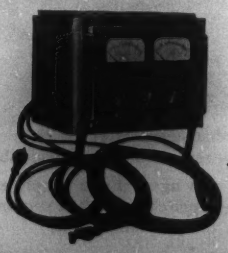
PORTABLE MODEL

This newest addition to the complete Biddle line of dielectric testing equipment has been specially designed for step-voltage resistance tests, voltage withstand, and breakdown tests on the insulation of such equipment as

- **rotating electrical machinery, dry-type transformers, switchgear, capacitors and insulators rated from 230 to 500 volts**
- **traction motors and generators**
- **wiring and cable installations**

Compact portable set is housed in shock and wear resistant case for severe field use in testing reconditioned equipment after installation, as well as for preventive maintenance of installed equipment. Also available in a bench model for making acceptance and proof test on electrical insulating systems for quality control in manufacturing and repair. For complete description, specifications and prices, WRITE FOR BULLETIN 22-5-EE.

- **High Maximum Output Current**
- **Suitable for Impulsing Faults**
- **Efficient Performance even in Humid Atmosphere**
- **Full-Wave Dry-Type Rectifier Assures Long Service Life**
- **Protected Against Damage by Short-Circuit at Maximum Output**
- **Built for Rough Handling in Field Service**
- **Available in Portable or Bench Models**



BENCH MODEL

8911

JAMES G. BIDDLE CO.

Electrical Testing Instruments • Speed Measuring Instruments
Laboratory & Scientific Equipment
1316 ARCH STREET, PHILADELPHIA 7, PA.

New & Improved Products

(Continued from page 26)

Pre-Engineered Plastic-Cable Splice Kits . . .

New splice kits for telephone cable are available for making two-, three-, and four-way splices. Each contains all the material required for splicing a particular joint with a minimum of waste. Included in each kit is a housing made from a durable composition of synthetic rubber and thermoplastic resins which resists acids, alkalis, oils, and is not harmed by water. Entrance of moisture is prevented by quickly applied, tight-fitting seals, and end caps. **G & W Electric Specialty Co., 3500 W. 127th St., Blue Island, Ill.**

Circle 220 on the card.

Lightweight Storage Battery . . .

Designed for aircraft application, this battery combines the extremely high energy of silver with the long life of cadmium to produce a unit 2½ times smaller and lighter than ordinary batteries of similar capacity. Weighing only 17 pounds, the *18YS18* has a 360-watt-hour 18-ampere-hour capacity. **Yardney Electric Corp., 40-50 Leonard St., New York 13, N. Y.**

Circle 221 on the card.

Brushless Generator . . .

A package brushless generator designed to eliminate sparking has wide application in oil well drilling operations, hospitals, construction projects, shipboard, radio and television stations, mines, quarries, and factories. Shorter and more streamlined, the generator has its auxiliary equipment compactly mounted within the yoke enclosures with direct mounting of a switchboard on top. A selection of adapters makes it possible to attach the generator to most any driver. Available in 100- to 175-kw, 60-cycle, 1,800-rpm units, the generator is designed to deliver a low telephone influence factor and minimum radio and television interference. **Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.**

Circle 222 on the card.

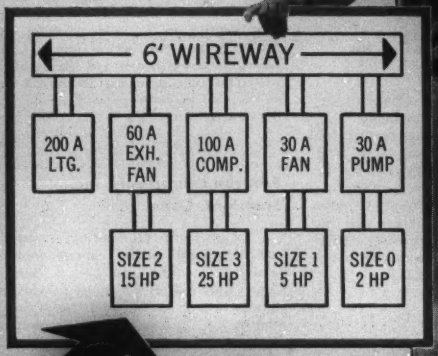
Efficiency Designed Transformers . . .

Self-supporting enclosures permitting more accessible entrance to sides, top, bottom, and back makes for quicker and easier installation of this redesigned line of dry-type transformers ranging up to 10,000 kva. Connections are facilitated by using solderless connectors in the terminal blocks. Units up to 75-kva single-phase and 45-kva 3-phase are furnished for interchangeable wall or floor mounting. **Sorgel Electric Co., Milwaukee, Wis.**

Circle 223 on the card.

STARTERS IN QMB PANELBOARDS!

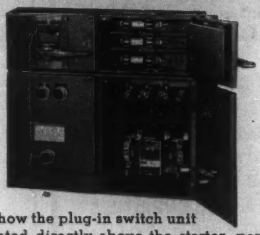
ANOTHER SQUARE D FIRST!



IT TAKES
41 HOURS AND 6 FEET
OF WALL SPACE TO INSTALL AND WIRE SWITCHES AND STARTERS LIKE THIS

IT TAKES
12 HOURS AND 30 INCHES
OF WALL SPACE FOR THE SAME INSTALLATION WITH A QMB STARTER PANELBOARD

Why mount separate starters and disconnect switches? It costs extra money. It wastes space. It takes a lot more time. QMB Starter Panelboards give you a *safer* installation because you can't open a starter when the switch is ON. They give you a much *better looking* job. Since they can even be *flush* mounted, they offer a lot more installation *flexibility*. QMB panelboards accommodate reversing and non-reversing starters, sizes 0 through 3. QMB switchboards and unit substations handle sizes 0 through 5. All of them are available, factory-assembled and wired. Or get enclosures, starters and plug-in switch units from your Square D distributor for on-the-job assembly.



Notice how the plug-in switch unit is mounted directly above the starter, permitting interlocking. The starter cannot be opened when the switch is in the "ON" position.

It's easy to order these starter and switch units. See Page 57 in your Square D Digest and order from your distributor.

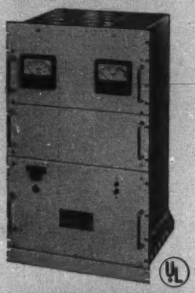
EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY

For more information circle 21 on reader service card.

D-C POWER

Precisely Regulated for Missile Testing and General Use



CHRISTIE

SILICON POWER SUPPLIES

available in 30 standardized and militarized models from 30 to 1500 amps... 6 to 135 volts. CHRISTIE'S QUALITY CONTROL is approved by the A.E.C., leading aircraft and missile manufacturers.

Write For Bulletin AC-58-A

CHRISTIE ELECTRIC CORP.

3410 W. 67th Street
Los Angeles 43, Calif.

Circle 22 on the card.

Industrial Notes...

The Dayton Rubber Co. Dayton, Ohio . . .

Entry of the Dayton Rubber Co., 10 Rubber St., Dayton 1, Ohio, into the industrial hose field has been announced by R. G. Burson, vice president of the firm's Industrial Products Division. The new line will include air, water, steam, suction, and pressure hoses in a full range of sizes and construction. Expanded production facilities and development of new construction techniques led to the decision to enter the industrial hose field.

North American Philips Co., Inc. Mt. Vernon, N. Y. . .

The Norelco Cryogenics Department, North American Philips Company, Inc., recently moved to a new location at 100 Stevens Ave., Mount Vernon, N. Y. The company manufactures compact units for the production of liquid nitrogen and for liquefying atmospheric gases. It also markets environmental chambers and refrigerating systems which are designed for specific situations where temperature requirements go as low as −320 F.

GHV Astronautics, Inc. Burlington, Mass. . .

This new firm will engage in research, development, and manufacture of ion propulsion devices that may send vehicles soaring through space at speeds of more than 100,000 miles an hour. The new venture is a joint enterprise of B. F. Goodrich Co., and of High Voltage Engineering Corp. The area of space technology to which Goodrich-High Voltage Astronautics, Inc. will devote its efforts includes the development of engines that will take over once a vehicle enters space. It will also work in the related area of power generation for the engines from nuclear and solar sources.

Jarrell-Ash Co. Newtonville, Mass. . .

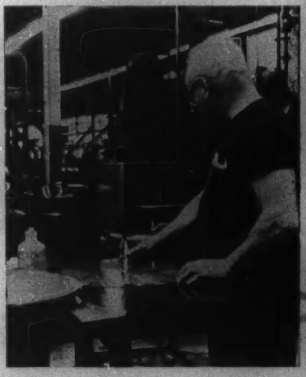
A new plane grating spectograph developed by Jarrell-Ash Co. offers high optical speed, f/6.3, and good dispersion, resolution, and spectral coverage in the ultraviolet and visible regions. Although high-speed spectrographs have been available before, the large quartz prisms required have been expensive, hard to obtain, and involved considerable sacrifice in dispersion especially in the higher wavelengths. The f/6.3 grating spectograph has been successfully employed to record the spectrum from transient shock tube, plasma phenomena lasting only 4 to 5 microseconds, according to the manufacturer. Especially designed for research of a similar nature where the source of light is weak or is of normal brilliance but fleeting, this unique spectrograph may be used with high-speed drum cameras to further extend its response to short duration events. The company is located at 26 Farwell St., Newtonville 60, Mass.

Hercon Electronics Corp. Newark, N. J. . .

Hermetic Connector Corp. of Newark, N. J., announces the formal changing of the company name to Hercon Electronics Corp. The address will remain the same, 481 Washington St., Newark, N. J., but the telephone number is now, MArket 2-2402. These changes are the result of the tremendous growth in the past 3 years at Hercon in both personnel and production facilities.

Branson Instruments, Inc. Stamford, Conn. . .

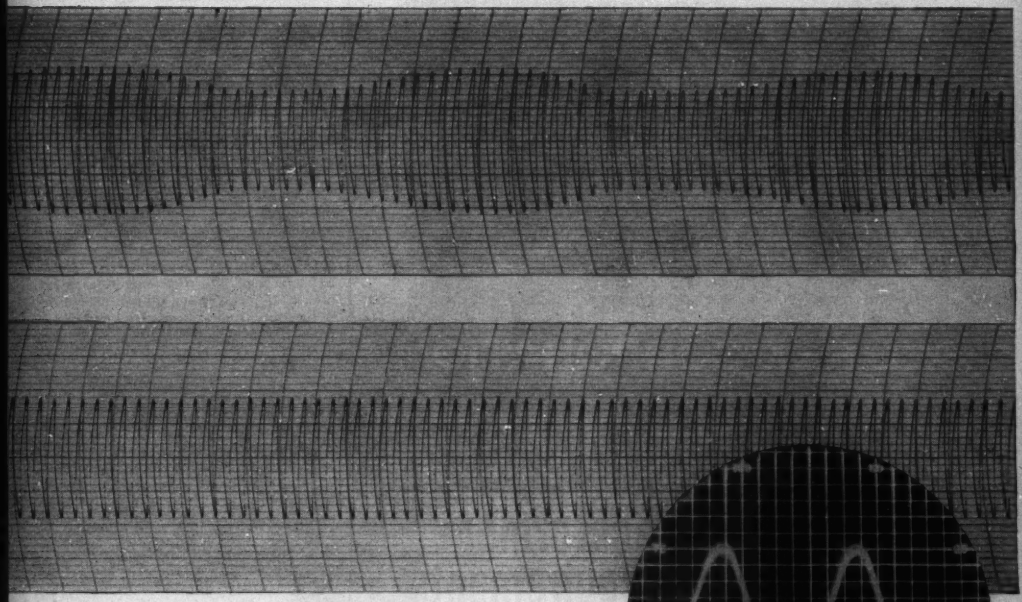
An ultrasonic resonance gage, used as one of several quality control tools, is saving Bridgeport Brass Co., Bridgeport, Conn., hundreds of dollars by providing a nondestructive test method. Inspection is simple, fast, and reliable. This company has developed a rim-to-rim laminated

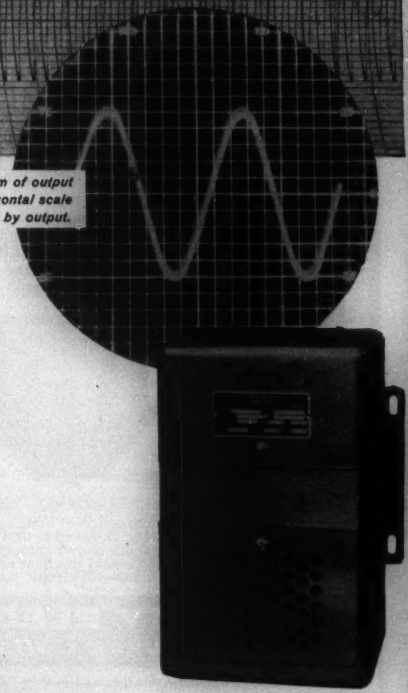


structure for its new line of kitchenware. An inner copper core is laminated between two disks of stainless, the finished blank then formed by a press and buffed to a high gloss. However, should there be any discontinuity in the bond, the blank may delaminate during drawing, or the defect may show up as a streak or blister after polishing. Three years ago, the company installed the ultrasonic tester, Model *14* Vidigage (registered trade mark), made by Branson Instruments, Inc., 40 Brown House Rd., Stamford, Conn., to check laminate strength.

(*Continued on page 34A*)

Sola Standard Sinusoidal Constant Voltage Transformer





OUTPUT from CV Transformer: *Oscilligram of output from same CV transformer uses expanded horizontal scale to picture commercial sine wave shape retained by output.*

New Prices of Sola Standard Sinusoidal Constant Voltage Transformers

Catalog Number	Output Rating, VA	Price Each	% Price Reduction
23-13-060	60	$30	6.2
23-13-112	120	38	5.0
23-13-125	250	52	17.5
23-13-150	500	81	14.7
23-13-210	1000	135	14.6
23-25-220	2000	245	10.9
23-25-230	3000	330	9.6
23-26-250	5000	515	new item
23-28-275	7500	900	new item

For more information circle 24 on reader service card.

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CUSTOM ENGINEERED RECTIFICATION

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No more tedious matching of cell characteristics when replacing a damaged semiconductor in a rectifier system. Sel-Rex Balancing Reactors *force even distribution of the load among all rectifying elements* — regardless of individual cell characteristics. Simply replace damaged elements with ones which are similarly rated. Another example of Sel-Rex "Custom-Engineering."

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Rectifier Division

SEL-REX CORPORATION

NUTLEY 10, NEW JERSEY — Representatives in Principal Cities

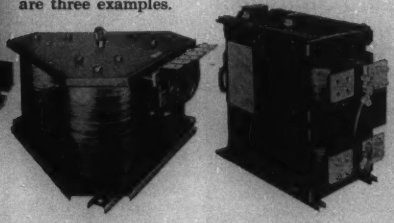
Complete Semiconductor Power Conversion Systems for any AC to DC application

▲ Circle 25 on the card.

▼ Circle 26 on the card.

let us fit the transformer to your design requirements

You need not limit your design to off-the-shelf components. Hevi-Duty specializes in adapting transformer designs to your specifications. Special ratings can be designed, manufactured, and delivered promptly. Here are three examples.



Motor Starting Auto transformer, used for manual or automatic reduced voltage starting of synchronous and induction motors. Terminals are mounted on the coil.

Air core current limiting reactor, designed to limit the short circuit current in a special application on a 550-volt circuit.

Molybdenum furnace power supply. Water-cooled output bus, single phase.

Further details or quotations available upon your request.

HEVI-DUTY ELECTRIC CO.

MILWAUKEE 1, WISCONSIN

Industrial Furnaces, Electric and Fuel • Dry Type Transformers
Constant Current Regulators

Industrial Notes

(*Continued from page 30A*)

Space Recovery Systems, Inc. El Segundo, Calif. . .

This new organization has been formed as a combined operation of CBS Laboratories, High Ridge Rd., Stamford, Conn., and M. Steinthal and Co. Inc., to provide research, engineering, and production for advance recovery systems designed to retrieve equipment and personnel from high altitudes, the upper atmosphere, and outer space; main offices have been established in El Segundo, Calif.

Sperry Rand Corp. Gainesville, Fla. . .

Plans to expand production of Sperry microwave tubes for advanced radars, missiles, and countermeasures systems, will be effected by increasing plant space to 121,000 square feet, increasing employment to more than 800, increasing total plant and equipment value to more than $6 million, and by increasing land site to 112 acres, from 47 acres. Sperry Electronic Tube Division, Sperry Rand Corp., Gainesville, Fla.

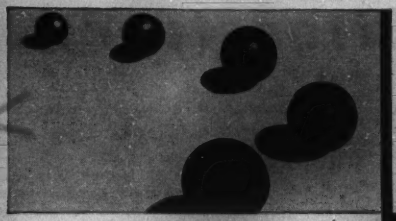
C&D Batteries, Inc. Conshohocken, Pa. . .

Clear plastic containers have replaced the molded hard rubber containers formerly used to house the largest type of PlastiCell (trade mark) and PlastiCal (registered trade mark) communication and control batteries. The change involves PlastiCell Type *CT* and PlastiCal Type *RCT* (now called *F* and *CF* respectively) communication batteries with capacities ranging from 720 to 1,680 ampere hours. It also affects PlastiCell Type *RF* and PlastiCal Type *RCF* control batteries (now called *PF* and *PCF* respectively) of from 880 to 1,650 ampere-hour capacity. As with all C & D batteries in plastic containers, high–low level lines provide instant indication of electrolyte level. C & D Batteries, Inc. Washington & Cherry Sts., Conshohocken, Pa.

Nems-Clarke Co. Silver Spring, Md. . .

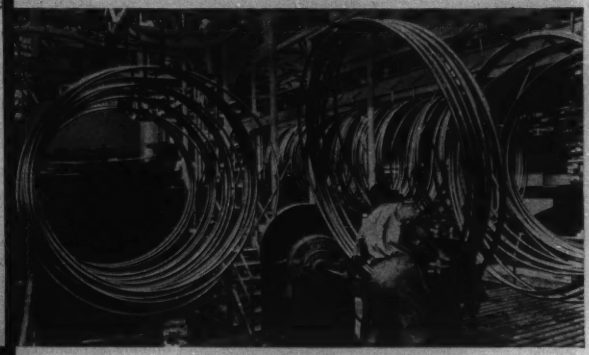
Additional manufacturing facilities in Martinsburg, W. Va., have been acquired by the Nems-Clarke Co., Silver Spring, Md., a Division of Vitro Corp. of America, 261 Madison Ave., New York 16, N. Y. The new facilities consist of a manufacturing plant and group of buildings, approximately 100,000 square feet in area, at the Martinsburg Municipal Airport, which have been operated by Thieblot Aircraft Co., another Division of Vitro Corp. These facilities will now become the Martinsburg Division of Nems-Clarke.

(*Continued on page 44A*)



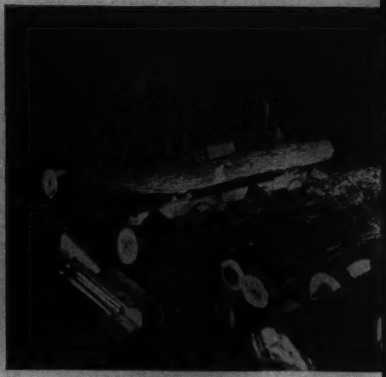
CALUMET DIVISION

LOOK TO CALUMET & HECLA...



WOLVERINE TUBE DIVISION

LOOK TO WOLVERINE TUBE



GOODMAN LUMBER DIVISION

URANIUM DIVISION

Mining . . . refining . . . lumbering . . . agriculture . . . manufacturing — diversified indeed are the product and market areas of the companies making up the industrial family of Calumet & Hecla, Inc.

Of course, Calumet & Hecla has for many years been recognized as a copper producer. Since 1859, in Michigan's Upper Peninsula, the Calumet Division has been mining Lake copper — one of the purest forms of copper ore. The refined product is sent to Wolverine Tube Division for conversion into brass and copper tubing for plumbing installations, refrigeration, chemical and petroleum processing as well as for a wide variety of general industrial applications. Wolverine Tube is also a prime manufacturer of aluminum extrusions, and drawn and extruded aluminum tube.

The Calumet Division is widely recognized for the quality of the grinding balls and mill liners it manufactures for the mining industry, as well as for the agricultural oxides it produces for better farming.

From the trees in the vast forest areas of Calumet & Hecla holdings, Goodman Lumber Division manufactures plywood and other wooden products. C&H properties have turned up high grade uranium. The development of these properties and the extraction of this valuable element is the responsibility of the Uranium Division.

If any of the above products fall within the scope of your company's requirements, remember that you pick a winner every time you deal with a member of the Calumet & Hecla industrial family.

When you need tubing—LOOK TO WOLVERINE!!

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URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION
In Canada:
CALUMET & HECLA OF CANADA LIMITED
WOLVERINE TUBE DIVISION
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Proceedings of the Fourth Conference on

MAGNETISM and MAGNETIC MATERIALS

More than 350 authorities here discuss results of recent research in magnetism and magnetic materials. Physics, chemistry, mathematics, metallurgy, chemical and electrical engineering fields are included, ranging from theoretical subjects to application, development, and manufacturing. New materials and associated circuitry in many components used in enginering; ferromagnetism and antiferromagnetism; spin wave resonance; optical absorption, etc., all covered. Sponsored by Magnetics Subcommittee of AIEE Committee on Basic Sciences. Special edition distributed through McGraw-Hill under arrangement with AIEE and in co-operation with *Journal of Applied Physics*. 323 pp., 8½ x 11, 235 illus., $10.00.

NUCLEAR ENGINEERING HANDBOOK

Comprehensive coverage of nuclear engineering presented at a practical level for engineers interested in industrial and other applications of nuclear energy. Techniques, theory, detailed data included. Edited by H. Etherington, ACF Industries, Inc. 1882 pp., $25.00

CONTROL ENGINEERS' HANDBOOK

Basic information on servomechanisms, regulators, and automatic feedback control systems. Components, design, and assembly techniques illustrated by specific discussions of regulators and systems. Edited by J. C. Truxal, Polytechnic Institute of Brooklyn. 1078 pp., $18.50

SYNTHESIS OF LINEAR COMMUNICATIONS NETWORKS

Translation of classic German work, in two volumes. Basic exposition of network analysis and synthesis; image parameter method; and mathematical extensions. By W. Cauer; edited by W. Klein and F. M. Pels; translated by G. E. Knausenberger and J. N. Warfield. 866 pp., $19.50

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Trade Literature...

Power Supplies Brochure . . .

A new line of compact, high-voltage power supplies intended specifically for such applications as cathode-ray oscilloscopes, electrostatic precipitation equipment, radar displays, image intensifiers, dielectric insulation testers, electron optical devices, storage tubes, and nuclear applications is fully illustrated and described in a brochure recently released by **Del Electronics Corp., 521 Homestead Ave., Mt. Vernon, N. Y.**

Aluminum Magnet Wire Brochure . . .

A six-page illustrated brochure on aluminum magnet wire discusses economic and functional advantages of aluminum magnet wire and gives valuable information on availabilities, properties, insulation characteristics, and standard techniques for winding and connecting. **Kaiser Aluminum & Chemical Sales, Inc., Department NR-34, 919 N. Michigan Ave., Chicago 11, Ill.**

Electronics Industry Fact Book, 1959 . . .

A 47-page fact book showing growth in many phases of the electronics industry, including military, industrial electronics, components, and consumer products is available from the **Electronic Industries Association, 1721 De Sales St., N. W., Washington 6, D. C.**

Walkie or Rider-Type Industrial Trucks . . .

"Walkie or Rider Trucks" gives the pros and cons for both the walkie and rider-type industrial trucks and how they are used in industry. Advantages and applications for both types of trucks are outlined, along with a convenient check list giving facts to consider when analyzing truck requirements. **Automatic Transportation Co., 149 W. 87th St., Chicago, Ill.**

Thermoplastic All-Purpose Control Cable Bulletin . . .

Bulletin *DM 5844* gives full technical data on Anaconda's thermoplastic all-purpose control cable with polyethylene insulation, double Densheath (PVC) jackets. Offered are excellent electrical characteristics, easy installation. The cable resists chemicals, mechanical abuse, moisture, and heat deformation. **Anaconda Wire & Cable Co., Dept. EFL, 24 Broadway, New York 4, N. Y.**

Booklet on Tables and Formulas of Electrical Data . . .

"Convenient Tables and Formulas," 120 pages, summarizes electrical data, properties of materials, heat transfer and steam information, measurements, and other subjects. For a copy of booklet *B-3677D*, call the nearest Westinghouse Apparatus Sales Office or write to **Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.**

Miniature Electrical Connector Catalog . . .

Design data and a brief description of the new Deutsch *DS* series miniature electrical connector with snap-in contacts and crimp-type terminations is available in an illustrated catalog from **The Deutsch Co., Electronic Components Division, 7000 Avalon Blvd., Los Angeles 3, Calif.**

Bulletin on Fuel Element Manufacture . . .

Engineers and others concerned with the design, erection, and operation of research reactors will be interested in the new bulletin on fuel element manufacture now available from The Babcock & Wilcox Co. Bulletin *NCB-1*, summarizes the manufacturing process of fuel elements at the nuclear facilities plant in Lynchburg, Va. **The Babcock & Wilcox Co., Boiler Division, Sales Department, 20 Van Buren Ave., S., Barberton, Ohio.**

Keys to Bearing Fits . . .

This 8-page manual contains instructions on preventing premature bearing failures and off-schedule removals, procedures on obtaining accurate bearing fits easily and economically, and engineering data assuring perfect bearing fits on all antifriction bearings. **Bearing Inspection, Inc., 3311 E. Gage Ave., Huntington Park, Calif.**

Folder on Heavy-Duty Fork Trucks . . .

A 6-page folder, illustrating and describing a new line of heavy-duty fork trucks, known as the Titan series, and containing detailed engineering information along with dimensions and specifications, is available from **The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.**

(Continued on page 40A)

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It's **KERITE** *that makes the difference*

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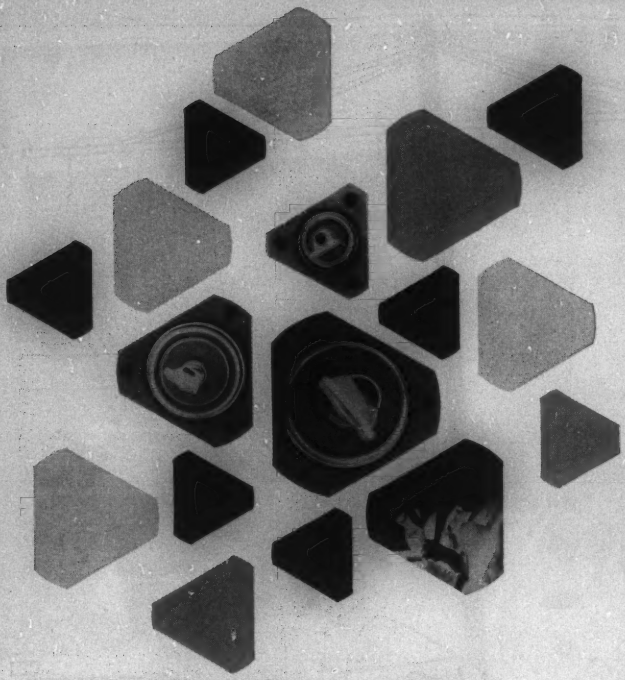

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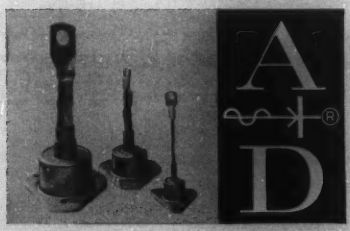
Silicon Rectifiers by Audio Devices establish new standards for high power industrial applications. Available in current ranges of 25 to 250 amperes (nominal, single-phase, half-wave rating), 50-400 PIV, with positive or negative base connections. Hermetically sealed AD Silicon Power Rectifiers provide users with longer life and more efficient operation under high temperature conditions. All units, including ½ amp. and up, now available from stock. For engineering data, write, wire or call RECTIFIER DIVISION, AUDIO DEVICES, INC., 620 E. DYER ROAD, SANTA ANA, CALIF. Kimberly 5-8241.

IN CANADA: Alex L. Clark, Ltd., Toronto 18, OVERSEAS EXPORT: ROCKE INTERNATIONAL CORPORATION, New York 16.



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Trade Literature

(Continued from page 38A)

Industrial Aluminum Foil Booklet . . .

A thought-provoking glimpse of the industrial uses of aluminum foil is provided in a 26-page booklet featuring a sparkling, four-color cover printed on foil. The book illustrates the many and varied uses for the thin metal in architectural, electrical, heating, cooling, printing, textile, industrial packaging, and other key applications. "Alcoa Industrial Aluminum Foil" is available by writing on company letterhead to **Aluminum Company of America, 782 Alcoa Bldg., Pittsburgh 19, Pa.**

Resistor, Capacitor, Switch Catalog . . .

This 40-page catalog lists over 1,700 stock variable resistors, ceramic capacitors, switches, and packaged circuits available from Centralab distributors. It contains 128 new products, including a full line of miniature 5-watt wire-wound variable resistors with ratings of 100 kilohms, 10 volt ultraminiature capacitors for transistor circuits, new variable resistor kits, and many other items. Detailed electrical and physical specifications are given for each item. **Centralab, a Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.**

Cellophane Bundling Booklet . . .

A 12-page booklet called "Cellophane Bundling" describes the advantages of cellophane over bulky opaque wrapping materials in bundling operations. Termed the "newest concept in redistribution packaging," cellophane bundling divides shipping case contents into easy-to-handle fractional units tailored to meet the needs of both the wholesaler and the retailer. **Market Development Department, American Viscose Corporation, Film Division, 1617 Pennsylvania Blvd., Philadelphia 3, Pa.**

Formica Designers Fact Book . . .

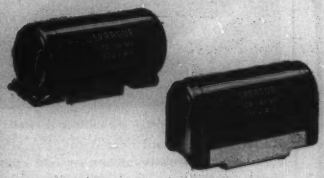
More than 50 industrial Formica (registered trade mark) laminated plastic grades, for products ranging from truck wheels to printed circuits are described in a Designer's Fact Book that contains a comparator chart itemizing the qualities of Formica's most popular grades, a listing of materials by military specification number, plus complete designer's information on all standard and special grades manufactured by Formica. **Formica Corp., Subsidiary of American Cyanamid Co., 4614 Spring Grove Ave., Cincinnati 32, Ohio.**

When you need CAPACITORS

for air-conditioners, refrigerators, motors, compressors, heat pumps, specialty transformers, voltage regulators, controls, and general purpose a-c applications

you get *fast* delivery from SPRAGUE

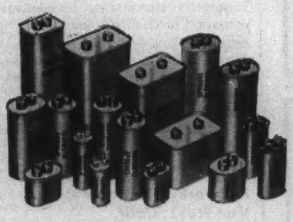
Sprague—*the world's largest capacitor manufacturer*—offers a complete line of motor capacitors to answer any equipment engineering problem. The types shown below cover a wide variety of application requirements. Take your pick—they're all tops in value and performance!



A-C ELECTROLYTIC CAPACITORS

for motor-starting service

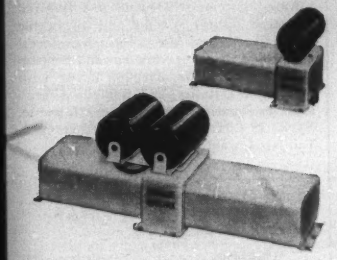
- withstand humid atmospheres
- rugged phenolic cases
- single or dual blade terminals to fit female quick-connectors
- all popular ratings and voltages
- Bulletin No. 4000A



CLORINOL® CAPACITORS

for motor-run service and general a-c applications

- drawn seamless steel cases for extra strength and compactness
- double-rolled cover closure eliminates "pop-outs"
- leakproof welded terminal assembly
- all ratings, three case styles
- available with metallic and lacquer finishes to customer specifications
- Bulletin No. 4500



KOOLPAK® CAPACITOR ASSEMBLIES

complete motor-start, motor-run assemblies for air-conditioners

- cooler operation extends capacitor life
- no trapped moisture to corrode metal parts
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- compact construction saves time and production costs
- available with metallic and lacquer finishes to customer specifications
- Bulletin No. 4900A

Write for Engineering Bulletins on the types in which you are interested. Application assistance is also available without obligation. Address request to Technical Literature Section, Sprague Electric Co., 321 Marshall St., North Adams, Massachusetts.

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CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
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CHIEF ENGINEER

ELECTRICAL APPARATUS AND DISTRIBUTION EQUIPMENT COMPANY

- **COMPANY**

  The company is one of the best known in the United States in the field of electrical apparatus and distribution equipment products. It has excellent growth and future development plans. Location is a very desirable city in the Midwest (not Chicago).

- **POSITION**

  The Chief Engineer will report to the Vice President. He will have complete responsibility for all engineering including product research and development through a staff of about 40 engineers and technical personnel.

- **EXPERIENCE**

  It is essential that his background and experience be in the administration of engineering research and development of low voltage circuit breaker type of products.

- **PERSONAL QUALIFICATIONS**

  Should have the imagination and creative ability to initiate and carry out an effective research and development program in addition to administering all engineering functions.

- **AGE AND EDUCATION**

  38 to 45 preferred. A Bachelor of Science Degree in Electrical Engineering is required. Any additional study is preferable.

- **COMPENSATION**

  The base salary is in the area of $16,000 to $18,000 plus a cash bonus which could run as high as 20 percent in addition to excellent fringe benefits.

- **CONFIDENTIAL**

  All replies for this advertisement will be handled by a well-known management consulting firm.

  Please reply to Box 27, Electrical Engineering, 33 West 39th St., New York 18, N.Y.

Second Report on Survey of Electric Utility Applications of Digital Computers

DECEMBER 1958

This report lists and describes briefly electric utility applications of digital computers. A revision of an earlier Conference Paper on the same subject, CP58-243, the report is reasonably complete, contributions having been solicited from every privately or publicly owned utility system with over 75,000 customer meters.

The extensive, 121-page report was prepared by the Computer Application Subcommittee of the AIEE System Engineering Committee, and the AIEE Applications Subcommittee of the AIEE Computing Devices Committee.

Publication S-*109* is available for the price of $1.50 from the Order Department,

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
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Electrical Engineers

Electrical engineers in a chemical company? Of course. Instrumentation, electrical control, systems engineering and utilities offer career opportunities for electrical design and development work with Monsanto. Engineering degree required plus up to 10 years experience. Job location in campus-like setting, suburban St. Louis.
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William R. Hayes
Asst. Personnel Director
Inorganic Division Dept. EE
Monsanto Chemical Company
St. Louis 66, Mo.

Monsanto

Industrial Notes

(Continued from page 34A)

Dow Corning Corp. Midland, Mich. . .

Silastic *RTV*, the Dow Corning silicone rubber that vulcanizes at room temperature, protects against shock, vibration, dirt, and moisture in electronic components. By potting and encapsulating with Silastic *RTV*, the units can be effectively sealed. Rigid parts and structures for missiles made with silicone resins retain excellent mechanical strength at temperatures that cause other materials to weaken.

Radar windows and heat dams that withstand continuous operation at 600 F and short exposure up to 1,500 F are now in use. Silicone fluids have essentially flat viscosity curves over a wide temperature range. By eliminating temperature compensation mechanisms, smaller, lighter, and more efficient damping units can be produced without sacrificing damping rates. The noncorrosive, nonconducting, nongumming characteristics of Dow Corning silicone fluids make them ideal for use in gyros, accelerometers, and magnetrons.

Networks Electronic Corp. Van Nuys, Calif. . .

Networks Infrared Science Laboratories for study and evaluation of advanced infrared systems will investigate infrared detection optical systems and applicable electronic devices. Also, a special engineering project group is to design and develop a high-power static inversion device with regulation, stability, and reliability specifications superior to those now attainable. Networks Electronic Corp., 14806 Oxnard, Van Nuys, Calif.

Public Service Electric & Gas Co. Newark, N. J. . .

A 290,000-kw generating unit has been placed in commercial operation at its Bergen Generating Station in Ridgefield, N. J., by Public Service Electric and Gas Co., 80 Park Place, Newark 1, N. J. The new generating unit consists of two shafts, each rotating at 3,600 rpm with identical electrical generators on each shaft. The most important feature of the design is the virtual duplication of the two parallel turbine-generator shafts, effecting economies in manufacturing, installation, and maintenance costs.

(Continued on page 48A)

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Industrial Notes

(Continued from page 44A)

Posen & Kline Tube Co. Norristown, Pa. . .

For the fifth time in less than 10 years Posen & Kline Tube Co., a subsidiary of Handy & Harman, has expanded to keep pace with the growing markets for precision-drawn, small diameter, stainless steel tubing. In the latest expansion, the specialty tubing manufacturer has added about 80% to its plant area and has doubled production capacity. The expansion is necessary, according to Mr. Travis, president of Handy & Harman, because of the steadily rising demand for small diameter precision tubing in rocket engines and atom power reactors. These new markets supplement well-established uses in the instrument, electronic, and medical equipment fields and particularly in the aviation industry where a single aircraft uses several thousand feet of tubing for hydraulic and fuel lines.

Dalto Corp. Jamaica, N. Y. . .

Eastern Airlines has placed an order with the Dalto Corp., Hotel Continental, New York International Airport, Jamaica 34, N. Y., for six visual flight simulator attachments, and has taken an option on two more. One of the first airlines to acquire the new pilot-training device, Eastern will utilize the closed circuit television system in connection with its low visibility approach instrument flight training program. Providing realistic simulation of the breakthrough (the transfer from instrument to visual flying), the instrument enables pilots to complete an approach, flare out, and land, coming to a full stop on the runway. It also permits the pilot to take off under the same conditions.

Bridgeport Brass Co. Bridgeport, Conn. . .

A less expensive and easier way to continue the flow of static electricity in a number of applications along oil and gas pipelines has been developed as part of Burndy Corporation's Thermoweld line of electrical connections for cathodic protection. This should have application with gas utility and gas transmission companies as well as oil and gas producers. The development is the replacement of copper cable around pipeline joint connections with Bridgeport Brass Company Soft Copper strip, resulting in 47% cost savings because of the greater footage per pound of strip cable. No loss of electrical conductivity is experienced and it is not necessary to insulate the copper strip against corrosion. The copper strip is far easier to weld to the pipe than any type of cable, and there is less chance of burning through the wall of pipe when welding. Bridgeport Brass Co., 30 Grand St., Bridgeport, Conn.